TELEPHONE
MEMO: (3/31/83)

~~FROM~~ TO: Ed Singer FILE NO. ______

PHONE NO.: SC 550-7270

Steve Fox asked me to call Ed and check out his concerns re: Pinellas County RRF

How will commission go - explained Power Plant Siting Review Committee

suggested he review old conditions of certification, w/ point out gaps for new project, also, if deficiencies seen a modification of existing conditions may be warranted

SIGNED KWA

WHILE YOU WERE OUT

To Buck

Date ______ Time ______

M Peter Hessling

of Pinellas County

Phone 570-6522 (Area Code / Number) Extension Junction

TELEPHONED		PLEASE CALL
CALLED TO SEE YOU		WILL CALL AGAIN
WANTS TO SEE YOU		URGENT
	RETURNED YOUR CALL	

Message re: Resource Recovery Plant
Environ Mgt
Stack Sampling Procedures

Operator ______

TO: Power Plant Siting Review Committee

FROM: Hamilton S. Oven, Jr.

DATE: March 31, 1983

SUBJECT: Pinellas County Resource Recovery Project

Pinellas County wants to add a third boiler and a 25 MW turbine to the already certified 50 MW Resource Recovery Project (PA 78-11). Please review the attached and comment on the adequacy of the attached materials by April 14, 1983. (Note: Division of Programs personnel should submit their comments to Frank Andrews by April 12, 1983.)

Pinellas County - 3/30/83

1. Third Boiler 1050 TPD
Air Qual Impact
PSD - PTMPT May Not be current
EPA prefers - ISC short term or MTER
Downwash Important
BACT important
Wants comments on Documents
2 ~~Expansion~~ -- New Application
DER copy old application - Pinellas
copies of any large drawing

Water Supply - Largo or St Pete
Largo preferred

Using Cattails instead of lilypads, USGS study to be available - Oxidation Pond

Review of Draft - Comment by 15 April
Additional MW Change

Fig 2-5 - U.S Homes Not Shown

1. Site Expansion - New land use Hearing
700 New Acres Documents 2nd ~~Top~~ Time of April -
Sludge farm may continue operating for awhile

Sod Farm -) Drainage off ~~[illegible]~~ Site
until 1987 - County - No control
Permit Status - Needs Clarification - City County
No Landfill till 2001

Permanent Leachate control
- Bentonite slurry cutoff wall keyed into on site clay - - perman 1x10 -6
Phase cut off walls into operation
Borings 500' centers
Accumulation + treatment of water
Stormwater runoff - less than 10 Yrs 24 hr
discharge must be 17-3

Wants permission to continue landfilling in water with promised slurry walls installation
Need to show that existing conditions are a permanent leachate control
April 7th Meeting in Tampa

Storm water Mgt
Monitoring For New area Bridgeway
II
Flaring of Landfill Gas
2 x 10^6 cu ft/day - Toytown.
- Burn @ plant site
+ Sludge Incineration

Pinellas County Resource Recovery Facility 3/30/83

Addition of 3rd boiler 1050 tons/day
Feels major impacts will be air

Larry George: need 2 application Federal PSD (to be reviewed by DER staff for EPA) + PPS Cert Application; PSD could be appendix to PPS

Want to submit only changes to original application rather than republish; OK; DER will recopy original as necessary (but may request large maps be done by Pinellas)

Deletion of hyacinths in oxidation pond - cat tails supposedly doing job

They want us to do a "fatal flaw" analysis of draft application; Buck says comments back around April 15

Will be an additional 25 MW turbine so will have to go to PSC for Need Determination

- Suggested they have blowup map of zoning for ~~around~~ ½ mile around site; new 17-17 requires info submitted at time of application

Site would then be 700 acres upon expanded

They want to file a "supplemental application" but 17-17 defines that as for sites previously certified for ultimate site capacity (which this was not); so may work out same, but more fee

They want to include Sod Farm in site;
City will be using as such until 1987 -
City would be responsible for drainage until that time, then County would revamp (problems right now) projection - no landfilling at Sod Farm until ≈ 2000
Handle Sod Farm permit as separate

They want to append Sod Farm application to PPSC; Buck says we can work something out

Permanent leachate control
- bentonite slurry around entire 730 acre site, permeability 10^{-6}
- they want to phase - do areas where want to landfill first

Pinellas County Resource Recovery Facility 3/30/83

Karen Anthony	DER/PPS	488-0130
Dr. Stan Crowe	DCAS	8-4925
E.G. Snipes	DER Tampa	985-7402
Larry George	DER/BAQM	488-1344
Jim Andrews	HDR	373-5485
Easel Roberts	HDR	402-399-1374
W. W. Dasher	Pinellas County - Operations	813-462-3184
Ace Acenbrack	P/C Solid Waste	(813) 825-1565
Gene E. Jordan	Pinellas County Public Works	813-726-3251
John A. Reese	DER/Solid Waste	488-0300
Ray L. Moreau	DER/Resource Recovery	488-0300
Don Kell	" Ground water	8-0300
Bob Van Deman	HDR, Clearwater	813-441-9405
C N Best	UOP	312-391-2089
Buck Oven	DER/PPS	488-0130

AGENDA

PINELLAS COUNTY REFUSE TO ENERGY FACILITY

SUPPLEMENTAL APPLICATION WORKSHOP

TALLAHASSEE, FLORIDA

MARCH 30, 1983

1. Third boiler
2. Expansion of site boundary
3. Landfill permit for the sod farm tract
4. Permanent leachate control
5. Ground water quality
6. Stormwater management
7. Flaring of landfill gas
8. Sludge incineration

1. Supplemental Application - Addition of a third boiler. See separate documents.

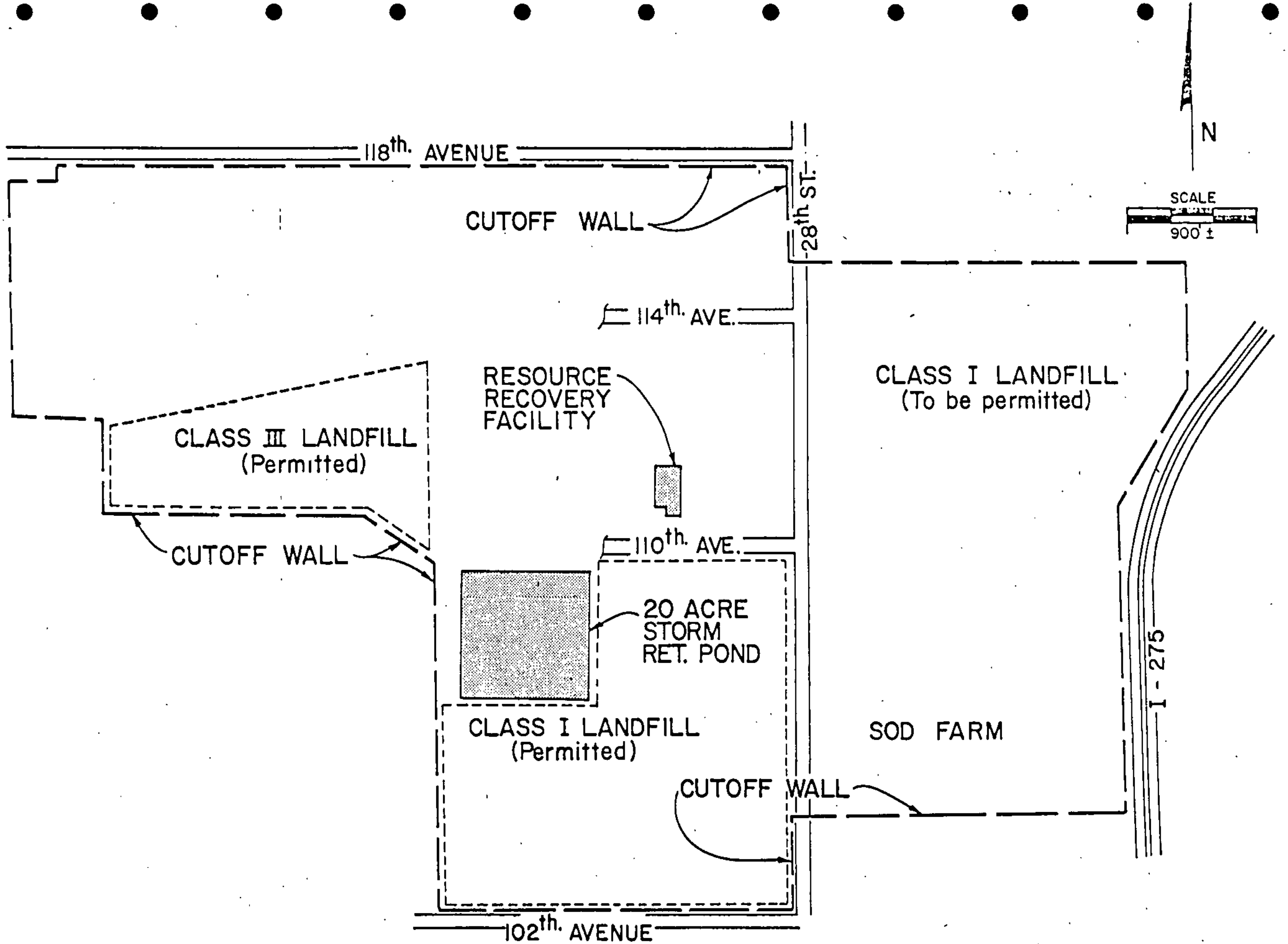
2. Expansion of site boundaries: Pinellas County is proposing that the Power Plant site boundary originally stated in the PPSA be expanded to include certain continuous land areas shown in Figure 1. These lands include the abandoned borrow pits to the northwest, the Bridgeway Acres I land fill extension, the open lands immediately north of the plant (south of 118th Ave., North), and the Sod Farm tracts east of 28th St., North. The proposed use of each tract is discussed in detail in subsequent portions of this document. In summary:

   A. Sod Farm tract - ClassI/III land fill.
   B. Land north of plant site - auxiliary storage area.
   C. Bridgeway Acres I Extension - Class III land fill.
   D. Borrow pits and land areas to the northwest and within the 10,000 foot limit of the St. Petersburg-Clearwater Airport - Storm water management and construction debris disposal.

   The proposed perimeter boundary will surround all lands to be considered the expanded power plant site. The old Windish landfill site, is also to be included. In addition, although the County will not assume management control of the operating Sod Farm from the City of St. Petersburg until that municipalities' permit for sludge disposal expires in 1987, it is also proposed for inclusion in this expansion.

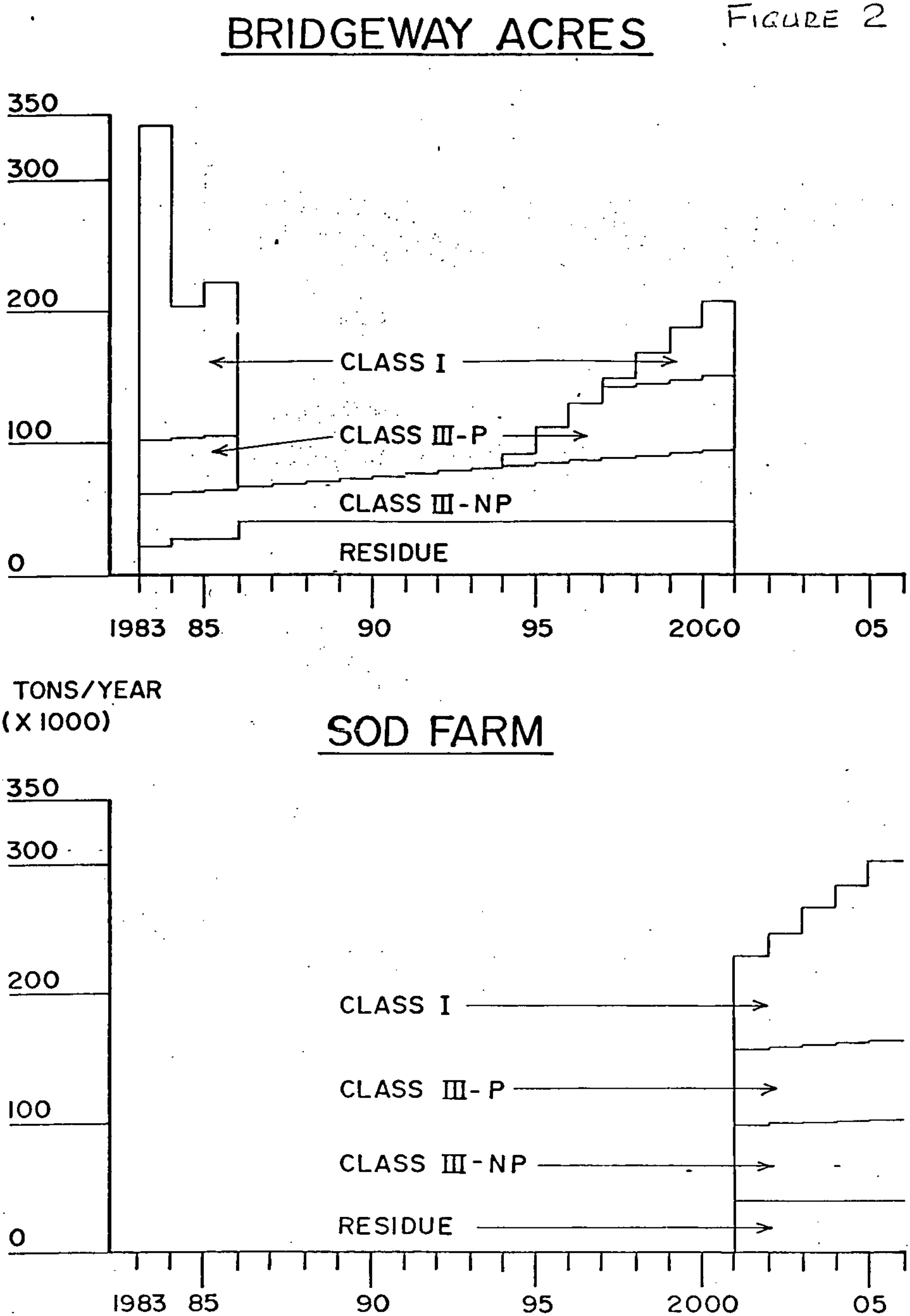
3. Landfill permit for the Sod Farm tract - The permit application is currently being finalized and will be submitted in accordance with guidelines established for the Bridgeway Acres II landfill of the original PPSA. The statutory amendments to Chapters 17-7, 17-17, 17-3, and 17-4 (FAC) since submittal of the original PPSA are addressed. Most notable of these is for monitoring wells. As depicted in Figure 2, the Sod Farm site will not receive any debris until after the Bridgeway Acres sites are filled, sometime after the turn of the century. As previously noted the County will not assume management of a portion of the Sod Farm tract (approximately the south 100 acres) until the City of St. Petersburg's permit for sludge disposal expires in 1987.

4. Permanent leachate control - Pursuant to Chapter 17-7 (FAC) disposal of solid waste below the ground water table can only occur if permanent leachate controls are installed to prevent the vertical and horizontal flow of leachate and contaminated ground waters from the landfill site. Based upon a review of a preliminary soils investigation and provided the required hydrogeological



PROPOSED SITE LAYOUT
FIGURE 1

FIGURE 2



BRIDGEWAY ACRES
350
300
200
100
0
CLASS I
CLASS III-P
CLASS III-NP
RESIDUE
1983 85
90
95
2000
05
TONS/YEAR
(X 1000)
SOD FARM
350
300
200
100
0
CLASS I
CLASS III-P
CLASS III-NP
RESIDUE
1983 85
90
95
2000
05

investigation confirms the existence of a clay and cemented clay strata, permanent leachate control for site landfills can be provided by surrounding the site with bentonite slurry wall constructed down through the permeable shallow sands and clayey fine sands in order to key the trench into the clays and cemented clays to prevent lateral movement of groundwater. The *in situ* clays act as a confining layer and retard vertical flow between the water table aquifer and the Floridian aquifer. Construction of the cut-off wall will, in effect, contain any contaminated water and preclude its horizontal and vertical movement.

Prior to the cut-off wall construction, an additional soils investigation shall be conducted along the proposed wall centerline at 500 foot centers to more accurately determine localized fluctuations of the various soil strata and to identify the water flow gradient and rates of flow through the soil.

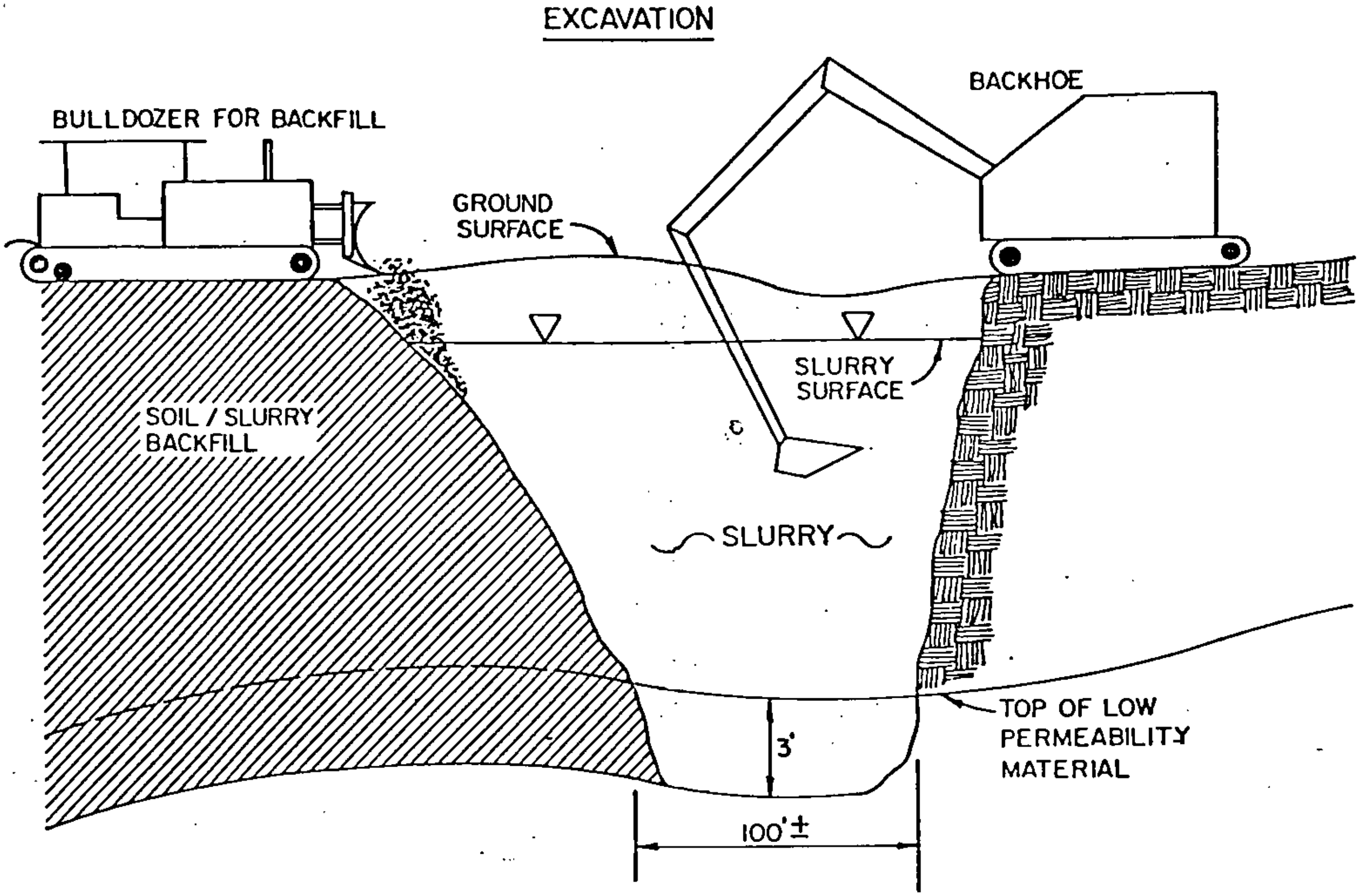
A slurry trench system (for the groundwater cut-off wall) is a proven method for permanent leachate control and has been in use in the U.S. for over 20 years. The type of construction we are proposing is called a soil-bentonite slurry cut-off wall. Construction involves excavating a trench that is kept filled with a bentonite slurry whose primary ingredients are bentonite clay and water. This mixtures' primary function is to keep the trench open to the bottom of the excavation. Once the trench is excavated to the final depth, a mixture of native soil and bentonite is mixed along-side the trench by a bulldozer and is placed into the trench displacing the bentonite slurry.

Excavation and backfilling are phased to keep the operation continuous with relatively small amounts of new slurry being required to keep the trench full and to mix the backfill. (See Figure 3)

The entire Resource Recovery Site, as proposed for amendment in the Supplemental Application will be surrounded by the cutoff walls. (Figure 1).

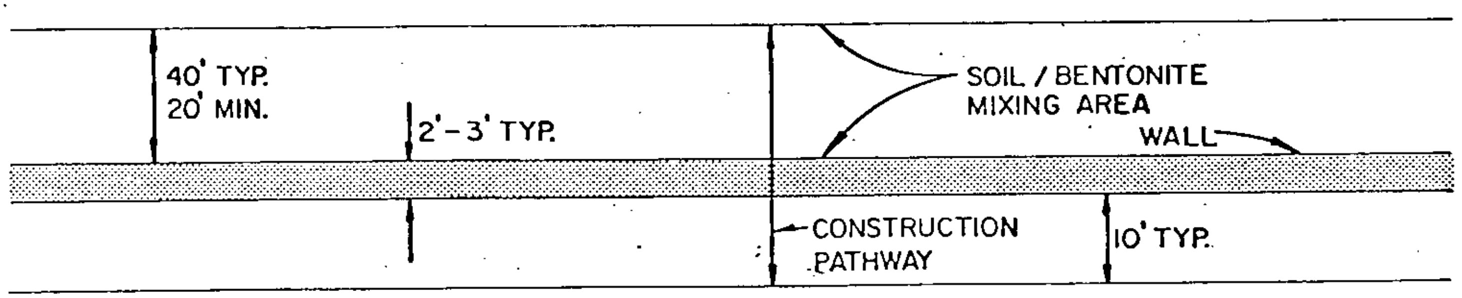
The cut-off wall will prevent any contaminants from moving horizontally into the water table aquifer and will last a minimum of 30 years. The precise chemical composition and thickness of the wall needed for this longevity will be determined when the additional soils work is performed. Wall thickness will be generally in the range of 2-3 feet wide.

Construction of the cut-off wall will be accomplished in 360 to 540 Calendar Days and will cost approximately $3,000,000.



TYPICAL CONSTRUCTION SECTION

NO SCALE



PLAN VIEW OF WALL

NO SCALE

FIGURE 3

TABLE I

GROUNDWATER (sites C3 – SF26)

PARAMETER[1]	1° & 2° DRINKING WATER STANDARDS	C3 MEAN	C3 MAX	I3 MEAN	I3 MAX	O3 MEAN	O3 MAX	LF18 MEAN	LF18 MAX	LF30 MEAN	LF30 MAX	63S MEAN	63S MAX	SF26 MEAN	SF26 MAX
Zn	5	.018	.02	.04	.1	.024	.04	.035	.12	.065	.1	.058	.12	.049	.15
SO_4	250	6.8	10	—	—	—	—	9.3	16	—	—	—	—	—	—
pH[2]	6.5	6.8	6.15	6.85	6.2	6.80	6.3	6.84	6.06	7.31	7.1	—	—	7.2	6.3
Fe	.3	4.78	6.8	.356	1.0	6.06	8.7	9.34	14	1	1.0	2.84	18	6.1	7.8
Cu	1	.0017	.008	.0025	.004	.0079	.004	[illegible]	.053	[illegible]	.011	—	—	.014	.041
Color[3]	15	5	5	—	—	—	—	30	50	—	—	63.3	100	118	150
Cl	250	151.5	260	162	330	121.6	210	232	430	6.2	6.9	188.5	230	214	280
As	.05	.0040	.007	.0074	.01	.0048	.01	.0048	.008	.003	.004	.0088	.042	.008	.011
Cd	.01	.0024	.012	.0025	.064	.0020	.008	.0033	.012	.0025	.001	[illegible]	.004	.0004	.002
Cr	.05	.019	.03	.009	.032	.0144	.03	.017	.03	.02	.02	.009	.03	.014	.02
Pb	.05	.0046	.013	.0067	.018	.0038	.01	.017	.069	.0059	.007	.046	.17	.02	.043
Hg	.002	.0003	.0009	.00034	.0006	.0012	.0006	[illegible]	.001	[illegible]	.005	.0004	.0018	.0002	.0009
Se	.01	[illegible]	.001	.0004	.001	.0004	.001	.00045	.001	—	—	—	—	—	—
Ag	.05	.0004	.002	.0004	.002	[illegible]	.002	.00025	.001	—	—	—	—	—	—
Na	160	197.7	160	203.5	320	89	120	162.8	280	4.9	5.5	72.1	120	147	160
NO_3-N	10	.02	.11	.015	.03	.12	.07	.006	.02	.37	1.1	99.2	300	.07	.32
Turbidity[4]	1 = MONTHLY 5 - 2 - DAY	38.1	80	29	40	35.2	110	48	100	35	65	—	—	—	—
Coliform (MPN)	1/100 ml 4/100 ml	4 (MF)	4 (MF)	—	—	—	—	1,134	4,600	—	—	1,715	15,000	182	2,300

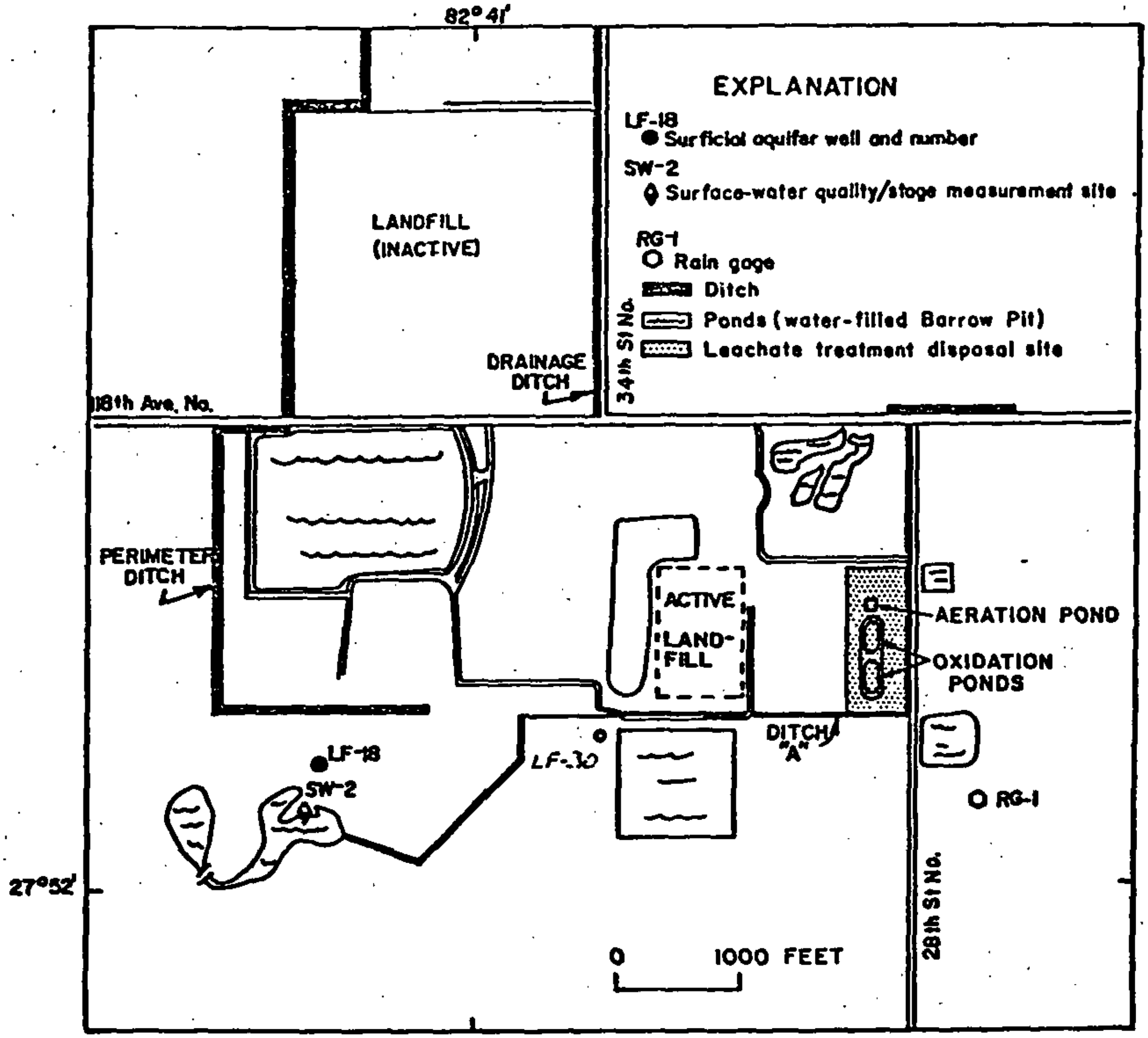
GROUNDWATER (sites 54D – 57)

PARAMETER[1]	54D MEAN	54D MAX	54S MEAN	54S MAX	55D MEAN	55D MAX	55S MEAN	55S MAX	56 MEAN	56 MAX	57 MEAN	57 MAX
Zn	.035	.15	.06	.15	.03	.07	.018	.03	.034	.25	.144	.99
SO_4	—	—	—	—	—	—	—	—	—	—	—	—
pH[2]	7.3	6.7	7.4	6.4	7.4	7.0	7.2	6.9	7.4	6.7	7.5	6.6
Fe	3.36	4.4	6.16	9.6	2.1	2.2	2.6	4.0	4.9	8.2	151	110
Cu	.027	.045	.029	.18	.0023	.004	.0038	.006	.02	.07	.099	.8
Color[3]	10.8	20	46	89	8.3	10	161.5	300	775	150	42.5	100
Cl	78	210	151	230	200	250	741	124	81	200	43.1	89
As	.002	.006	.0013	.007	.0015	.002	.0019	.002	.005	.007	.009	.058
Cd	[illegible]	[illegible]	[illegible]	.004	.0002	.001	.0003	.001	.0012	.004	.0009	.015
Cr	.011	.02	.0151	.03	.0008	.001	.0008	.002	.012	.03	.069	.34
Pb	.05	.16	.023	.08	.005	.008	.0058	.015	.041	.14	.071	.32
Hg	.0002	[illegible]	[illegible]	.0007	.0011	.0011	.0005	.0005	.0002	.0005	.0002	.0009
Se	—	—	—	—	—	—	—	—	—	—	—	—
Ag	—	—	—	—	—	—	—	—	—	—	—	—
Na	64.2	120	108.2	150	77	78	30.7	50	21.3	30	26.1	31
NO_3-N	2.1	18	25.1	120	.01	.04	.01	.02	.02	.11	.06	.19
Turbidity[4]	—	—	—	—	—	—	—	—	—	—	—	—
Coliform (MPN)	234	2,400	1,063	9,300	46	46	8,001	28,000	26	150	1,226	110,000

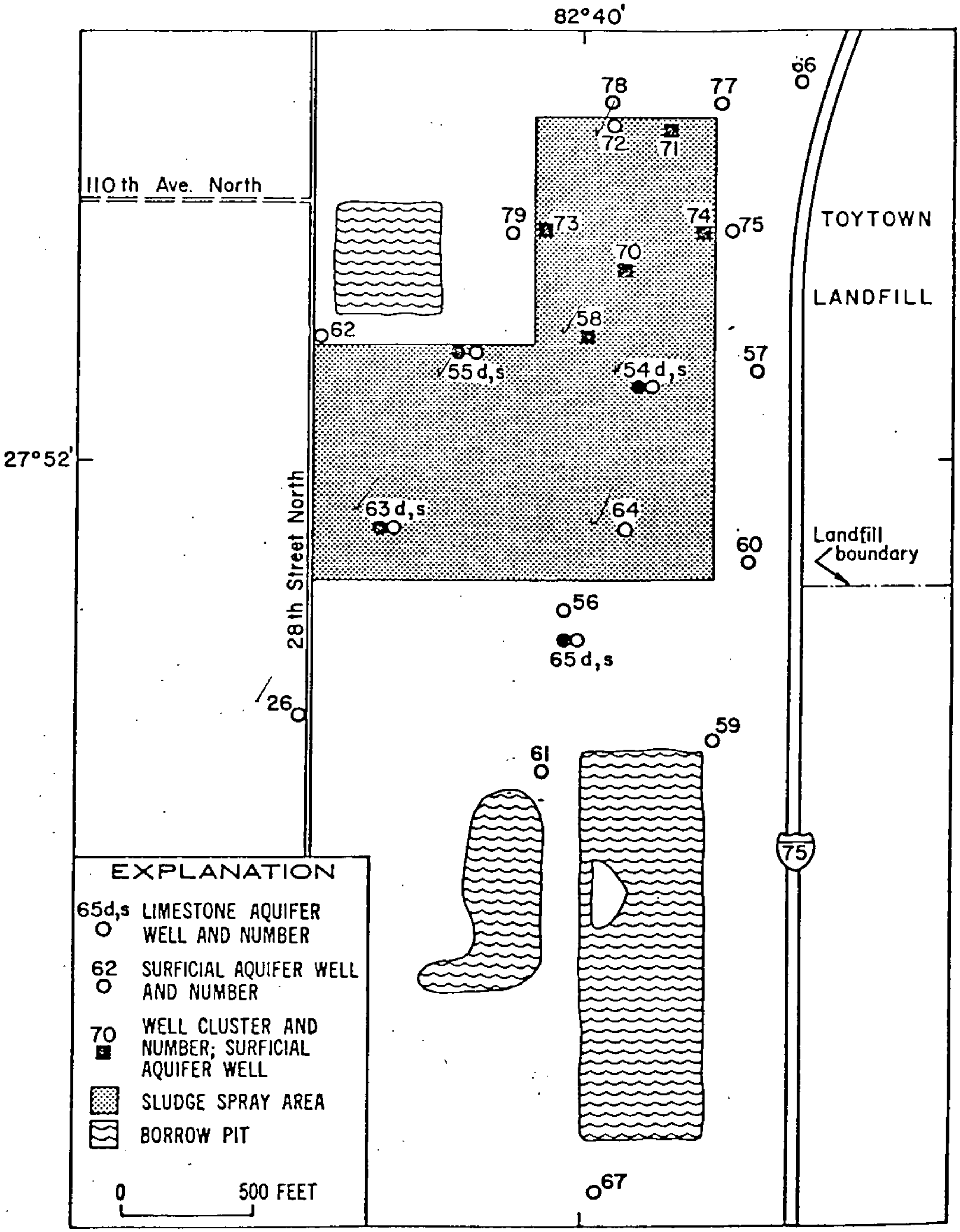
GROUNDWATER (sites 58 – 64), RAW LEACHATE, SURFACE WATER

PARAMETER[1]	58 MEAN	58 MAX	60 MEAN	60 MAX	61 MEAN	61 MAX	62 MEAN	62 MAX	66 MEAN	66 MAX	64 MEAN	64 MAX	RAW LEACHATE MEAN	RAW LEACHATE MAX	SURFACE WATER AERATION POND MEAN	SURFACE WATER AERATION POND MAX
Zn	.051	.13	.062	.23	.075	.13	.032	.06	.028	.06	.057	.16	.373	.79	.2	.53
SO_4	—	—	—	—	—	—	—	—	—	—	—	—	—	—	47	47
pH[2]	7.2	6.4	7.3	6.7	7.4	7.2	7.1	6.5	7.3	6.1	7.3	6.5	6.87	6.2	8.2	6.99
Fe	5.7	20	4.96	69	6.4	6.8	6.2	11	3.76	9.4	6.66	36	80	86	1.94	8.7
Cu	.022	.059	.018	.130	.029	.047	.008	.017	.0099	.022	.033	.40	.0247	.066	.0036	.006
Color[3]	46.7	60	38.3	90	45	40	15	20	32	65	20	22	—	—	0	0
Cl	32.8	110	199.2	210	192	250	61.2	70	31.2	43	146.8	280	108	130	110	200
As	[illegible]	.012	.0075	.036	[illegible]	.005	.0038	.009	.0099	.016	.0034	.004	.0253	.061	.0033	.008
Cd	.0004	.002	.002	.007	0	.09	.0005	.008	.0013	.001	.001	.003	.0027	.004	.00133	.002
Cr	.008	.01	.036	.20	0	0	.025	.04	.02	.03	.016	.02	.2	.35	.0333	.06
Pb	.02	.483	.043	.100	.19	.035	.016	.021	.016	.03	.439	2.2	.036	.097	.00567	.09
Hg	.0001	[illegible]	.0002	[illegible]	—	—	.0006	.0024	[illegible]	.0006	.0002	.0012	.00054	.001	.000467	.001
Se	—	—	—	—	—	—	—	—	—	—	—	—	.022	.022	.001	.001
Ag	—	—	—	—	—	—	—	—	—	—	—	—	0	0	.000667	.002
Na	33.6	48	84.7	110	92	95	37.2	50	19.9	26	96.2	126	98.3	160	90	140
NO_3-N	7.3	84	.03	.19	0	0	.01	.03	.38	4.4	73.7	150	.41	.8	.04	.15
Turbidity[4]	—	—	—	—	—	—	—	—	—	—	—	—	3712	11000	47	130
Coliform (MPN)	4,123	46,000	2,597	35,000	420	790	878	4,600	9,427	210,000	4,466	46,000	1.32×10^6	2.9×10^6	573,000 FECAL	2.2×10^6

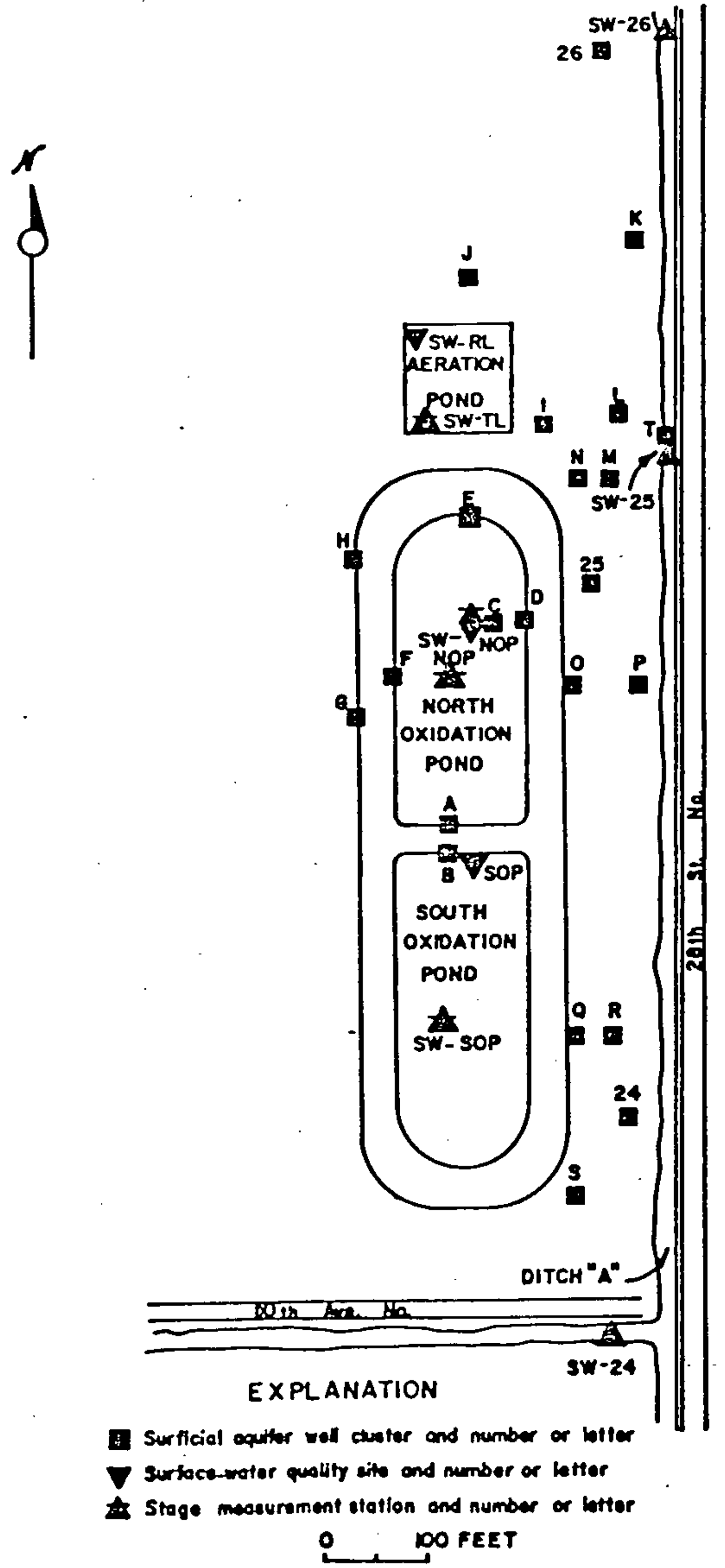
1. ALL IN MG/L UNLESS NOTED
2. pH UNITS
3. Pt-Co UNITS
4. NTU



.--Study area showing landfill-leachate treatment and disposal, and background ground- and surface-water quality-monitoring sites.



--Location of ground-water quality monitoring wells at the sludge disposal site.



—Location of well clusters and surface-water quality monitoring sites at the leachate treatment and disposal sites.

5. Ground Water Quality - Under the ground water rule amendments promulgated this past January the surficial unconfined aquifer beneath the power plant site is classified as C-II (potable water use). As such, the primary and secondary drinking water standards for public water systems must be met in addition to the minimum criteria ("free froms") stated in chapter 17-3.402 (FAC). Statisitical analysis of data compiled by the U.S.G.S. at the site and adjacent areas over the past decade indicate that the actual quality of underlying ground water does not meet the above criteria (see Table 1). It is apparent that this untoward quality is not limited to waters beneath the site proper but also encompasses adjacent areas (see LF-18, Table 1).

The causes of this situation are difficult to ascertain but an historical note here is appropriate. At least seventy five years ago, before Pinellas County became a separate governmental body (from Hillsborough County), the low-lying, flood prone Pinellas peninsula became a regional dump site. As the area became more populated the dumping became concentrated into specific areas including the current plant site. As such existing water quality in the surface aquifer is, in part, the product of abuses initiated before the County began managed landfill operations at the current location. The severity of contamination varies with location and with the parameter in question. From Table 1 it is observed that Iron, Coliform, Turbidity and Color standards are exceeded in virtually all samples at all sites. Minimum PH values are also routinely violated. In addition certain wells show occasional trace metal values which exceed those for G-II waters. The continuous monitoring program soon to be implemented as part of the Conditions of Certification (COC) of the original PPSA will attempt to further quantity and qualify this situation, both inside and outside of surrounding cutoff walls.

Regardless of the classification of underlying groundwater , Pinellas County intends to pursue a comprehensive program of permanent leachate control, leachate/stormwater management and water quality monitoring to ensure that ground waters adjacent to the proposed PPSA site expansion are not adversely affected by activitives associated with facility operation. The County is requesting that the DER recognize that the background quality of water beneath and adjacent to the site does not meet the criteria and standards accorded to G-II designated waters.

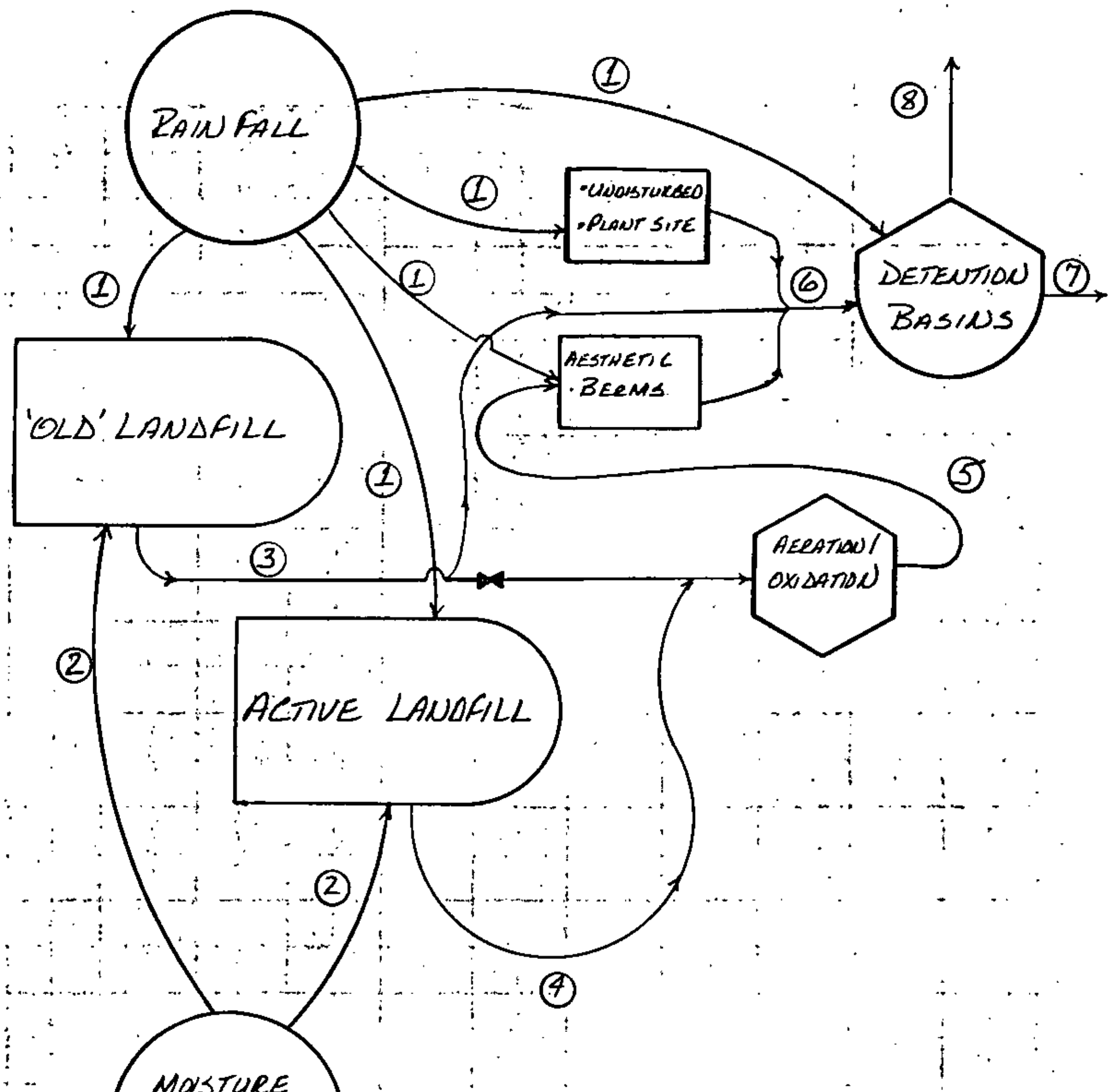
6. Stormwater management - Once permanent leachate controls are installed the water budget scheme depicted in Figure 4 is visualized. All water imported to the site (rainfall, waste moisture), aside from piped supplies (potable and tertiary), will be detained on-site in accordance with Section XIV.D-1, COC. As shown, "sour" water from active landfill cell dewatering will be routed through the

HDR

Project ______ Computed ______

Subject ______ Date ______ Sht. ____ Of ____

FIGURE 4 : WATER MANAGEMENT SCHEME



FLOW DESCRIPTION

① DIRECT PRECIPITATION

② MOISTURE IN SOLID WASTE

③ WATER COLLECTED IN DITCHES

④ 'SOUR' WATER TO TREATMENT

⑤ EFFLUENT TO LAND SPRAY

⑥ RUNOFF TO DETENTION

⑦ DISCHARGE (SECT. XIV.D-1 COC)

⑧ EVAPORATION

facilities aeration/oxidation pond system for treatment. The pond effluent will be land sprayed on perimeter berms. Runoff collected from all other site areas (with the exception of the active sod farm) will be collected within the bentonite cutoff walls in perimeter canals. At this point it can be conveyed to the aeration/ioxidation ponds or directed to the borrow pits at the northwest corner of the PPSA site expansion. It is estimated that 220 acre-ft. of storage are available in the larger pit, while the smaller pit contains an additional 40 acre-ft. Water routed to these basins will be detained until such time that any discharge from the site satisfies the minimum criteria for Class III surface waters as stipulated in Chapter 17-3 (FAC) for any storm event of less the 10-year intensity. Preliminary calculations indicate that sufficient storage volume exists in the pits to satisfy this condition. A detailed mathematical model is currently being formulated and will be applied in the overall water management plan. The model focuses on the following situations:

A. The increased flow of runoff as more land is converted to landfill.
B. Dilution rates in the holding basins.
C. Concentration rates (due to runoff in flow) in the holding basins.
D. Average meteorological conditions.
E. Severe meteorological conditions (drought/flood).
F. Alternative piping schemes for routing stormwater into treatment cells (aeration/oxidation ponds) and for dilution of concentrated flows.

Presently runoff from the active sod farm (south 100 acres) is routed into borrow pits located south of the proposed PPSA site expansion and east of 28th St., North. As previously stated, Pinellas County will not assume operational control of this site until 1987. It is proposed that the runoff from this site continue to be transmitted to these pits until Pinellas County acquires full use of the sod farm. At that time stormwater from the sod farm will be incorporated into the overall site program.

7. <u>Flaring of landfill methane gas</u> - Pinellas County is proposing to install a package boiler unit adjacent to the plant main building to burn landfill gases, primarily methane. The gas is to be obtained initially from the Toytown land fill. In the future, as landfill activities move to the sod farm site gases will be collected from those sites as well. UOP Inc., is the plant contractor and will operate the package boiler.

8. <u>Sludge Incineration</u> - An environmentally sound manner of residual disposal is incineration. Domestic wastewater sludge and kitchen grade grease can be effectively incinerated if they are properly suspended in an emulsion and applied on to the grates (or the solid waste on the grates) of the proposed third boiler at the power plant. UOP, Inc. acknowledges that the use of special sludge applicators (called slingers) are now being tested in Europe to apply this type emulsion. Based on these test results it is proposed that a similar operation be implemented at the PPSA site. This will entail the installation of storage tanks to accept

incoming domestic sludge, grease, and required emulsifiers. These structures are to be sited just north of the plant scale houses. The process will involve the mixing of grease, sludge and emulsifier and the application of this mixture to the grates. It is especially critical that the mixture be incinerated on the grates and not in the atmosphere to minimize fouling of boiler tubes and the electrostatic precipitators. This is accomplished by the sludge slingers which are installed directly on the boiler tube wall.

No hazardous sludges or septage will be accepted at the plant. Each sludge and grease truck will be sampled for compliance. The sludge/grease mixture must be of sufficient dryness to burn, therefor on-site dewatering maybe required. A tipping fee will be assessed to haulers based on moisture content of waste.

INITIAL COMPLIANCE TEST

PINELLAS COUNTY RESOURCE RECOVERY PLANT

Prepared For:

UOP, INC.
3001 110TH AVENUE NORTH
ST. PETERSBURG, FLORIDA

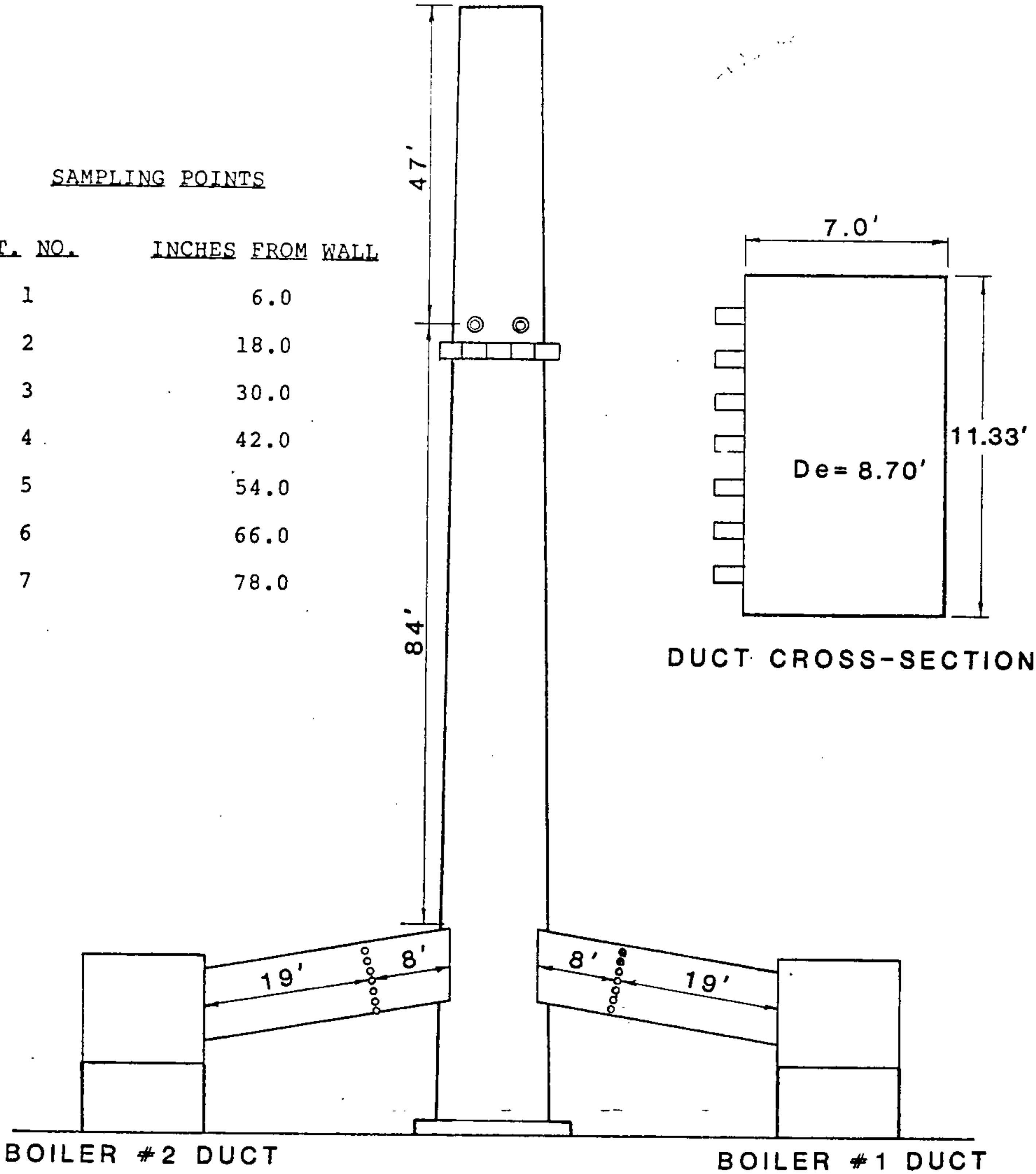
Prepared By:

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.
5119 NORTH FLORIDA AVENUE
TAMPA, FLORIDA

May 26, 1983

SAMPLING POINTS

PT. NO.	INCHES FROM WALL
1	6.0
2	18.0
3	30.0
4	42.0
5	54.0
6	66.0
7	78.0



TEST LOCATION DIMENSIONS PINELLAS CO. RESOURCE RECOVERY PLANT	
ENVIRONMENTAL ENGINEERING CONSULTANTS, INC. CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS	Figure 1

I. SUMMARY

On April 27, 28, and 29, 1983 Environmental Engineering Consultants, Inc. conducted emissions tests at the Pinellas County Resource Recovery Facility in St. Petersburg, Florida. The sources tested were two boilers burning municipal garbage to generate electriciy. Particulate matter emission rates for certification of EPA New Source Performance Standards and FDER annual compliance certification were determined according to EPA Method 1-5. Sulfur dioxide emission rates for FDER annual compliance certification were determined according to EPA Method 6. Opacity density for FDER annual certification was determined according to EPA Method 9.

The tests were conducted by Carl Fink, Bob Soich, Jack Fross, and Jon Hull of Environmental Engineering Consultants, Inc. with the assistance and cooperation of Bill Whitman and the employees of UOP, Inc.

A summary of the test results are shown in Tables 1 and 2. The average particulate emission concentrations corrected to 50% excess air were 0.0227 gr/dscf for Boiler No.1 and 0.0257 gr/dscf for Boiler No.2. The average particulate emission concentrations corrected to 12% carbon dioxide were 0.0230 gr/dscf for Boiler No.1 and 0.0256 gr/dscf for Boiler No. 2. The average sulfur dioxide emission rates were 0.22 lb/MBTU for Boiler No.1 and 0.17 lb/MBTU for Boiler No. 2. No visible emissions were observed during a one-hour test period.

Each boiler was being operated at 100 +/- 10% of its rated capacity during all test runs.

TABLE 1 - TEST SUMMATION

Plant: Pinellas County Resource Recovery

Source: Boiler No. 1

Test Parameters: Particulate Matter (PART), Sulfur Dioxide (SO2)

Date: April 27 & 28, 1983

Run No.	SCF	SCFM	% H2O	Ts, °F	% ISO
1	57.811	123,794	14.04	460	93.6
2	60.357	126,750	13.63	452	95.5
3	59.314	121,647	13.53	449	97.8

Run No.	PART gr/dscf (12% CO2)	PART gr/dscf (50% EA)	SO2 lb/MBTU*
1	0.0219	0.0218	0.24
2	0.0156	0.0155	--**
3	0.0314	0.0309	0.20
Average	0.0230	0.0227	0.22
Allowable	0.08	0.08	1.2

* Results of an emission determination separate from the particulate tests.

** Sample voided due to zero emissions indication - caused by problem in one particular sampling train.

TABLE 2 - TEST SUMMATION

Plant: Pinellas County Resource Recovery

Source: Boiler No. 2

Test Parameters: Particulate Matter (PART), Sulfur Dioxide (SO2)

Date: April 29, 1983

Run No.	SCF	SCFM	% H2O	Ts, F	% ISO
1	59.422	120,530	14.55	464	98.9
2	57.396	118,062	14.62	472	97.5
3	59.849	120,800	14.58	474	99.4

Run No.	PART gr/dscf (12% CO2)	PART gr/dscf (50% EA)	SO2 lb/MBTU*
1	0.0283	0.0279	0.18
2	0.0255	0.0260	--**
3	0.0233	0.0229	0.16
Average	0.0257	0.0256	0.17
Allowable	0.08	0.08	1.2

* Results of an emission determination separate from the particulate tests.

** Sample voided due to zero emissions indication - caused by problem in one particular sampling train.

APPENDIX A

TEST DATA AND CALCULATIONS

SOURCE TESTING NOMENCLATURE AND DIMENSIONS

An: Cross sectional area of nozzle, ft2

As: Cross sectional area of stack, ft2

Bws: Water vapor in the gas stream, proportion by volume

Cs: Concentration of particulate matter in stack gas at the standard condition, gr/DSCF

Cs50: Concentration corrected to 50% excess air

Cs12: Concentration corrected to 12% carbon dioxide

Cp: Pitot tube coefficient

E: Source emission rate, lbs/hr

EA: Percent excess air

Md: Molecular weight of stack gas, dry basis, lb/lb-mole

Ms: Molecular weight of stack gas, wet basis, lb/lb-mole

Mn: Total particulate collected, less acetone and filter blank corrections; grams

Pb: Barometric pressure at test site, in Hg

Ps: Absolute stack gas pressure, mmHg

Qs: Volumetric flow rate, dry at standard conditions, SCFM

Tm: Absolute average dry gas meter temperature, ^{o}R

Ts: Absolute average stack gas temerature, ^{o}R

Vlc: Total volume of liquid collected in impingers and silica gel, ml

Vm: Volume of gas sampled under actual conditions, DCF

Vm(std): Volume of gas sampled corrected of standard conditions, DSCF

Vs: Stack gas velocity, ft/sec

Vw: Volume of water in sample corrected to standard conditions, SCF

Y: Dry gas meter calibration factor

Θ: Total sampling time, min.

ΔP: Velocity head, in H_2O

ΔH: Average pressure differential across orifice meter, in H_2O

SUMMARY OF TEST DATA

Plant: Pinellas County Resource Recovery Source: Boiler No. 2

	Run 1	Run 2	Run 3
Date:	4-29-83	4-29-83	4-29-83
Time Interval:	0901-1058	1353-1544	1620-1803
Test Time, min.:	98	98	98
Steam Production, lb/hr:	260,000	260,000	260,000
Stack Area, Sq. ft.:	80.50	80.50	80.50
Nozzle Diameter, in.:	.274	.274	.274
Barometric Pressure, in.Hg.:	30.15	30.13	30.13
Absolute Stack Pressure, in. Hg.:	30.13	30.11	30.11
Volume Liquid Collected, ml:	214.9	208.6	216.9
Stack Gas Temperature, °F:	464	472	474
Stack Gas Moisture Content, %:	14.55	14.62	14.58
Sample Volume, DSCF:	59.422	57.396	59.849
Gas Velocity, FPS:	50.789	50.255	51.506
Gas Flowrate, SCFM:	120,530	118,062	120,800
Gas Flowrate, ACFM:	245,311	242,731	248,774
Percent Isokinetic:	98.9	97.5	99.4
Percent CO_2, Volume:	9.5	9.6	9.7
Percent O_2, Volume:	9.9	10.1	9.8
Percent CO, Volume:	-	-	-
Percent N_2, Volume:	80.6	80.3	80.5
Percent EA, Volume:	87.0	91.0	88.6
Particulate collected, grams:	0.0862	0.0759	0.0719
Concentration, gr/DSCF:	0.0224	0.0204	0.0185
C_{s50}, gr/DSCF:	0.0279	0.0260	0.0233
C_{s12}, gr/DSCF:	0.0283	0.0255	0.0229
SO_2 emissions, lb/MBTU:*	0.18	-	0.16

* Result of an emission determination separate from particulate tests

Vs: Stack gas velocity, ft/sec

Vw: Volume of water in sample corrected to standard conditions, SCF

Y: Dry gas meter calibration factor

θ: Total sampling time, min.

ΔP: Velocity head, in H_2O

ΔH: Average pressure differential acress orifice meter, in H_2O

SUMMARY OF TEST DATA

Plant: Pinellas County Resource Recovery Source: Boiler No.1

	Run 1	Run 2	Run 3
Date:	4-27-83	4-27-83	4-28-83
Time Interval:	1416-1610	1731-1924	0911-1102
Test Time, min.:	98	98	98
Steam Production, lb/hr:	267,000	261,000	263,000
Stack Area, Sq. ft.:	80.50	80.50	80.50
Nozzle Diameter, in.:	.274	.274	.274
Barometric Pressure, in.Hg.:	30.06	30.06	30.13
Absolute Stack Pressure, in. Hg.:	30.04	30.04	30.11
Volume Liquid Collected, ml:	200.5	202.2	197.1
Stack Gas Temperature, F:	460	452	449
Stack Gas Moisture Content, %:	14.04	13.63	13.53
Sample Volume, DSCF:	57.811	60.357	59.314
Gas Velocity, FPS:	51.786	52.312	49.866
Gas Flowrate, SCFM:	123,794	126,750	121,647
Gas Flowrate, ACFM:	250,126	252,667	240,853
Percent Isokinetic:	93.6	95.5	97.8
Percent CO2, Volume:	9.3	9.3	9.2
Percent O2, Volume:	10.2	10.2	10.2
Percent CO, Volume:	-	-	-
Percent N2, Volume:	80.5	80.5	80.6
Percent EA, Volume:	92.3	92.3	92.1
Particulate collected, grams:	0.0636	0.0473	0.0926
Concentration, gr/DSCF:	0.0170	0.0121	0.0241
Cs50, gr/DSCF:	0.0218	0.0155	0.0309
Cs12, gr/DSCF:	0.0219	0.0156	0.0314
SO2 emissions, lb/MBTU:*	0.24	-	0.20

* Result of an emission determination separate from particulate tests.

PLANT	UOP
	Pinellas Co. Resource Recovery
SOURCE	BOILER #1
DATE	4-27-83
RUN NO.	1

CALIBRATION

C_p	.84	
Y	1.008	
D_n	.274	in.
A_n	4.095×10^{-4}	ft^2

NEW DATA

P_b	30.06	in. Hg
P_s	30.04	in. Hg
A_s	80.5	ft^2
θ	98	min
* V_m	60.971	DCF
ΔH	1.39	in. H_2O
T_m	552	°R
T_s	920	°R
V_{lc}	200.5	ml
$(\sqrt{\Delta P})_{avg.}$	0.6923	
M_n	0.0636	g.

* not corrected for leakage

$V_{m\ corrected} = V_m - (L_f - L_a)\theta = 60.971 - (.035 - .02)(98) = 59.501$ DCF

$$V_{m(std)} = \frac{17.64\ V_m Y \left(P_b + \Delta H/13.6\right)}{T_m} =$$

$$\frac{17.64\,(59.501)(1.008)\left(30.06 + \frac{1.39}{13.6}\right)}{(552)} = 57.8106 \text{ DSCF}$$

$V_w = 0.0471\ V_{lc} = 0.0471\,(200.5) = 9.4436$ SCF

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.4436)}{(9.4436) + (57.8106)} = 0.1404$$

$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$

$0.44(9.3) + 0.32(10.2) + 0.28(80.5) = 29.896$

$M_s = M_d(1 - B_{ws}) + 18\,B_{ws} = (29.896)(.8596) + 18(.1404) = 28.2258$

$V_s = 85.49\ C_p\,(\sqrt{\Delta P})_{avg.}\left(T_s / P_s M_s\right)^{1/2} =$

$$85.49(.84)(.6923)\left[\frac{(920)}{(30.04)(28.2258)}\right]^{1/2} = 51.7857 \text{ FPS}$$

$Q_s = 1058\,(1 - B_{ws})\,V_s\,A_s\,(P_s/T_s) =$

$$1058\,(.8596)(51.7857)(80.5)\frac{(30.04)}{(920)} = 123{,}794 \text{ SCFM}$$

$$I = \frac{100\ V_{m(std)} A_s}{\theta\ Q_s\ A_n} = \frac{100\,(57.8106)(80.5)}{(98)(123{,}794)(4.095 \times 10^{-4})} = 93.6\ \%$$

$$C_s = 15.43\frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0636)}{(57.8106)} = 0.0170 \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(10.2) - .5(0) \times 100}{.264(80.5) - [(10.2) - .5(0)]} = 92.29\ \%$$

$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$

$C_{s_{50}} = 0.0218$ gr/dscf

$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$

$C_{s_{12}} = 0.0219$ gr/dscf

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT UOP
PINELLAS CO. RESOURCE RECOVERY

SOURCE Boiler #1

DATE 4-27-83

RUN NO. 2

CALIBRATION

C_p	.84	
Y	1.008	
D_n	.274	in.
A_n	4.095×10^{-4}	ft^2

NEW DATA

P_b	30.06	in. Hg
P_s	30.04	in. Hg
A_s	80.5	ft^2
θ	98	min.
V_m	61.666	DCF
ΔH	1.43	in. H_2O
T_m	548	°R
T_s	912	°R
V_{lc}	202.2	ml
$(\sqrt{\Delta P})_{avg.}$	0.7030	
M_n	0.0473	g.

$$V_{m(std)} = \frac{17.64\, V_m Y (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(61.666)(1.008)(30.06 + \frac{1.43}{13.6})}{(548)} = 60.3573 \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471(202.2) = 9.5236 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.5236)}{(9.5236)+(60.3573)} = 0.1363$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.3) + 0.32(10.2) + 0.28(80.5) = 29.896$$

$$M_s = M_d(1-B_{ws}) + 18 B_{ws} = (29.896)(.8637) + 18(.1363) = 28.2746$$

$$V_s = 85.49\, C_p (\sqrt{\Delta P})_{avg.} (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.7030)\left[\frac{(912)}{(30.04)(28.2746)}\right]^{1/2} = 52.3117 \text{ FPS}$$

$$Q_s = 1058(1-B_{ws}) V_s A_s (P_s/T_s) =$$

$$1058(.8637)(52.3117)(80.5)\frac{(30.04)}{(912)} = 126{,}750 \text{ SCFM}$$

$$I = \frac{100\, V_{m(std)} A_s}{\theta\, Q_s\, A_n} = \frac{100(60.3573)(80.5)}{(98)(126{,}750)(4.095 \times 10^{-4})} = 95.5\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0473)}{(60.3573)} = 0.0121 \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(10.2) - .5(0) \times 100}{.264(80.5) - [(10.2) - .5(0)]} = 92.29\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$$C_{s_{50}} = 0.0155 \text{ gr/dscf}$$

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$$C_{s_{12}} = 0.0156 \text{ gr/dscf}$$

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL ...

PLANT: UOP
Pinellas Co.
Resource Recovery

SOURCE: Boiler #1

DATE: 4-28-83

RUN NO. 3

CALIBRATION

C_p	.84
Y	1.008
D_n	.274 in.
A_n	4.095×10^{-4} ft²

NEW DATA

P_b	30.13 in. Hg
P_s	30.11 in. Hg
A_s	80.5 ft²
θ	98 min
V_m	59.920 DCF
ΔH	1.35 in. H_2O
T_m	543 °R
T_s	909 °R
V_{lc}	197.1 ml
$(\sqrt{\Delta P})_{avg.}$	0.6720
M_n	0.0926 g.

$$V_{m(std)} = \frac{17.64\ V_m\ Y\ (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(59.920)(1.008)(30.13 + \frac{1.35}{13.6})}{(543)} = 59.3142 \text{ DSCF}$$

$$V_w = 0.0471\ V_{lc} = 0.0471(197.1) = 9.2834 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.2834)}{(9.2834) + (59.3142)} = 0.1353$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.2) + 0.32(10.2) + 0.28(80.6) = 29.88$$

$$M_s = M_d(1 - B_{ws}) + 18 B_{ws} = (29.88)(.8647) + 18(.1353) = 28.2726$$

$$V_s = 85.49\ C_p\ (\sqrt{\Delta P})_{avg.}\ (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.6720)\left[\frac{(909)}{(30.11)(28.2726)}\right]^{1/2} = 49.8663 \text{ FPS}$$

$$Q_s = 1058(1 - B_{ws})\ V_s\ A_s\ (P_s / T_s) =$$

$$1058(.8647)(49.8663)(80.5)\frac{(30.11)}{(909)} = 121,647 \text{ SCFM}$$

$$I = \frac{100\ V_{m(std)}\ A_s}{\theta\ Q_s\ A_n} = \frac{100(59.3142)(80.5)}{(98)(121,647)(4.095 \times 10^{-4})} = 97.8\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0926)}{(59.3142)} = 0.0241 \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(10.2) - .5(0) \times 100}{.264(80.6) - [(10.2) - .5(0)]} = 92.07\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$$C_{s_{50}} = 0.0309 \text{ gr/dscf}$$

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$$C_{s_{12}} = 0.0314 \text{ gr/dscf}$$

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT UOP
PINELLAS CO. RESOURCE RECOVERY

SOURCE BOILER #2

DATE 4-28-83

RUN NO. MOISTURE & VOL. FLOWRATE

CALIBRATION

C_p	.84	
Y	1.008	
D_n	–	in.
A_n	–	ft^2

NEW DATA

P_b	30.13	in. Hg
P_s	30.11	in. Hg
A_s	80.5	ft^2
θ	49	min.
V_m	32.133	DCF
ΔH	1.50	in. H_2O
T_m	555	°R
T_s	923	°R
V_{lc}	87.9	ml
$(\sqrt{\Delta P})_{avg.}$	0.6918	
M_n	—	g.

$$V_{m(std)} = \frac{17.64\ V_m Y\ (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(32.133)(1.008)(30.13 + \frac{1.50}{13.6})}{(555)} = 31.1317 \text{ DSCF}$$

$$V_w = 0.0471\ V_{lc} = 0.0471(87.9) = 4.1401 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(4.1401)}{(4.1901)+(31.1317)} = 0.1174$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.6) + 0.32(10.0) + 0.28(80.4) = 29.936$$

$$M_s = M_d(1-B_{ws}) + 18\,B_{ws} = (29.936)(.8826) + 18(.1174) = 28.5347$$

$$V_s = 85.49\ C_p\ (\sqrt{\Delta P})_{avg.}\ (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.6918)\left[\frac{(923)}{(30.11)(28.5347)}\right]^{1/2} = 51.4913 \text{ FPS}$$

$$Q_s = 1058\,(1-B_{ws})\,V_s\,A_s\,(P_s/T_s) =$$

$$1058\,(.8826)(51.4913)(80.5)\frac{(30.11)}{(923)} = 126,267 \text{ SCFM}$$

$$I = \frac{100\ V_{m(std)}\ A_s}{\theta\ Q_s\ A_n} = \frac{100(\quad)(\quad)}{(\quad)(\quad)(\quad)} = \_\_\_\_ \%$$

$$C_s = 15.43\frac{M_n}{V_{m(std)}} = \frac{(15.43)(\quad)}{(\quad)} = \_\_\_\_ \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(\quad) - .5(\quad) \times 100}{.264(\quad) - [(\quad) - .5(\quad)]} = \_\_\_\_ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$C_{s_{50}}$ = ______ gr/dscf

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$C_{s_{12}}$ = ______ gr/dscf

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT UOP
Pinellas Co. Resource Recovery

SOURCE Boiler #2

DATE 4-29-83

RUN NO. 1

CALIBRATION

C_p	.84	
Y	1.008	
D_n	.274	in.
A_n	4.095×10^{-4}	ft^2

NEW DATA

P_b	30.15	in. Hg
P_s	30.13	in. Hg
A_s	80.50	ft^2
θ	98	min.
V_m	60.100	DCF
ΔH	1.35	in. H_2O
T_m	544	°R
T_s	924	°R
V_{lc}	214.9	ml
$(\sqrt{\Delta P})_{avg.}$	0.6780	
M_n	0.0862	g.

$$V_{m(std)} = \frac{17.64\, V_m Y \left(P_b + \Delta H/13.6\right)}{T_m} =$$

$$\frac{17.64(60.100)(1.008)(30.15 + \frac{1.35}{13.6})}{(544)} = \underline{59.4223} \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471(214.9) = \underline{10.1218} \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(10.1218)}{(10.1218) + (59.4223)} = \underline{0.1455}$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$
$$0.44(9.5) + 0.32(9.9) + 0.28(80.6) = \underline{29.916}$$

$$M_s = M_d(1 - B_{ws}) + 18 B_{ws} = (29.916)(.8545) + 18(.1455) = \underline{28.1822}$$

$$V_s = 85.49\, C_p (\sqrt{\Delta P})_{avg.} \left(T_s / P_s M_s\right)^{1/2} =$$

$$85.49(.84)(.6780)\left[\frac{(924)}{(30.13)(28.1822)}\right]^{1/2} = \underline{50.7894} \text{ FPS}$$

$$Q_s = 1058(1 - B_{ws}) V_s A_s (P_s / T_s) =$$

$$1058(.8545)(50.7894)(80.5)\frac{(30.13)}{(924)} = \underline{120,530} \text{ SCFM}$$

$$I = \frac{100\, V_{m(std)} A_s}{\theta\, Q_s A_n} = \frac{100(59.4223)(80.5)}{(98)(120,530)(4.095 \times 10^{-4})} = \underline{98.9}\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0862)}{(59.4223)} = \underline{0.0224} \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(9.9) - .5(0) \times 100}{.264(80.6) - [(9.9) - .5(0)]} = \underline{87.01}\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$$C_{s_{50}} = \underline{0.0279} \text{ gr/dscf}$$

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$$C_{s_{12}} = \underline{0.0283} \text{ gr/dscf}$$

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT	UOP PINELLAS CO. RESOURCE RECOVERY
SOURCE	BOILER # 2
DATE	4-29-83
RUN NO.	2

CALIBRATION

C_p	0.84
Y	1.008
D_n	.274 in.
A_n	4.095×10^{-4} ft²

NEW DATA

P_b	30.13 in. Hg
P_s	30.11 in. Hg
A_s	80.50 ft²
θ	98 min.
V_m	59.692 DCF
ΔH	1.34 in. H_2O
T_m	559 °R
T_s	932 °R
V_{lc}	208.6 ml
$(\sqrt{\Delta P})_{avg.}$	0.6679
M_n	0.0759 g.

$$V_{m(std)} = \frac{17.64\, V_m Y\, (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(59.692)(1.008)(30.13 + \frac{1.34}{13.6})}{(559)} = \underline{57.3958} \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471\,(208.6) = \underline{9.8251} \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.8251)}{(9.8251)+(57.3958)} = \underline{0.1462}$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.6) + 0.32(10.1) + 0.28(80.3) = \underline{29.94}$$

$$M_s = M_d(1-B_{ws}) + 18\, B_{ws} = (29.94)(.8538) + 18(.1462) = \underline{28.1944}$$

$$V_s = 85.49\, C_p\, (\sqrt{\Delta P})_{avg.}\, (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.6679)\left[\frac{(932)}{(30.11)(28.1944)}\right]^{1/2} = \underline{50.2548} \text{ FPS}$$

$$Q_s = 1058\,(1-B_{ws})\, V_s\, A_s\, (P_s/T_s) =$$

$$1058\,(.8538)(50.2548)(80.5)\frac{(30.11)}{(932)} = \underline{118{,}062} \text{ SCFM}$$

$$I = \frac{100\, V_{m(std)}\, A_s}{\theta\, Q_s\, A_n} = \frac{100\,(57.3958)(80.5)}{(98)(118{,}062)(4.095\times 10^{-4})} = \underline{97.5}\ \%$$

$$C_s = 15.43\,\frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0759)}{(57.3958)} = \underline{0.0204} \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(10.1) - .5(0) \times 100}{.264(80.3) - [(10.1) - .5(0)]} = \underline{91.00}\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$$C_{s_{50}} = \underline{0.0260} \text{ gr/dscf}$$

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$$C_{s_{12}} = \underline{0.0255} \text{ gr/dscf}$$

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT UOP
PINELLAS COUNTY RESOURCE RECOVERY

SOURCE BOILER #2

DATE 4-29-83

RUN NO. 3

CALIBRATION

C_p	.84	
Y	1.008	
D_n	.274	in.
A_n	4.095×10^{-4}	ft^2

NEW DATA

P_b	30.13	in. Hg
P_s	30.11	in. Hg
A_s	80.50	ft^2
θ	98	min
V_m	61.678	DCF
ΔH	1.40	in. H_2O
T_m	554	°R
T_s	934	°R
V_{lc}	216.9	ml
$(\sqrt{\Delta P})_{avg.}$	.6839	
M_n	0.0719	g

$$V_{m(std)} = \frac{17.64\ V_m Y\ (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(61.678)(1.008)(30.13 + \frac{1.40}{13.6})}{(554)} = \underline{59.8494}\ \text{DSCF}$$

$$V_w = 0.0471\ V_{lc} = 0.0471(216.9) = \underline{10.2160}\ \text{SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(10.2160)}{(10.2160)+(59.8494)} = \underline{0.1458}$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.7) + 0.32(9.8) + 0.28(80.5) = \underline{29.944}$$

$$M_s = M_d(1-B_{ws}) + 18B_{ws} = (29.944)(.8542) + 18(.1458) = \underline{28.2026}$$

$$V_s = 85.49\ C_p\ (\sqrt{\Delta P})_{avg.}\ (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.6839)\left[\frac{(934)}{(30.11)(28.2026)}\right]^{1/2} = \underline{51.5063}\ \text{FPS}$$

$$Q_s = 1058(1-B_{ws})\ V_s\ A_s\ (P_s/T_s) =$$

$$1058(.8542)(51.5063)(80.5)\frac{(30.11)}{(934)} = \underline{120{,}800}\ \text{SCFM}$$

$$I = \frac{100\ V_{m(std)}\ A_s}{\theta\ Q_s\ A_n} = \frac{100(59.8494)(80.5)}{(98)(120{,}800)(4.095 \times 10^{-4})} = \underline{99.4}\ \%$$

$$C_s = 15.43\frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0719)}{(59.8494)} = \underline{0.0185}\ \text{gr/SCF}$$

$$\%EA = \frac{(\%O_2 - .5\%CO) \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{[(9.8) - .5(0.0)] \times 100}{.264(80.5) - [(9.8) - .5(0.0)]} = \underline{88.57}\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$$C_{s_{50}} = \underline{0.0233}\ \text{gr/dscf}$$

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$$C_{s_{12}} = \underline{0.0229}\ \text{gr/dscf}$$

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS,
ENVIRONMENTAL ...

DETERMINATION OF SULFUR DIOXIDE

DATE SAMPLED 4-27-83 RUN NO. 1 - Boiler No. 1

C_{SO_2} Concentration of SO_2 @ Standard Conditions, dry basis, lb/dscf

N	=	Normality of barium chloride titrant, meq/ml	=	0.00987
V_a	=	Volume of sample aliquot, ml	=	20
V_{soln}	=	Volume solution in which SO_2 sample is contained, 100ml	=	100
V_t	=	Volume of $BaCl_2$ titrant for sample, ml	=	2.81
V_{tb}	=	Volume of $BaCl_2$ titrant for blank, ml	=	0.03
K_2	=	Constant, 7.061 X 10^{-5} lb/meq	=	
V_{mstd}	=	Dry gas volume, corrected to standard conditions, dscf	=	0.689

$$Cso_2 = K_2 \left(\frac{(Vt - Vtb)\ N\ (\frac{Vsoln}{Va})}{Vm_{std}} \right) \text{ lb/dscf} = 1.406 \times 10^{-5}$$

Qsstd = Stack gas volumetric flowrate, dscf/hr. = 7.605×10^6

PMR_1 = Cso2 Qssdd = 106.92 lb/hr

PPM = Cso2 (6.017×10^6) = 85 ppm

$$E_{SO_2} = \frac{PMR_1}{H_{input}} = \frac{(106.92)\ \text{lb/hr}}{437\ \text{MBTU/hr}} = 0.24\ \text{lb/MBTU}$$

All Other values calculated as above:

Run No. 2 - Boiler No. 1 - $E_{SO_2} < 0.005$ - SAMPLE VOID *

Run No. 3 - Boiler No. 1 - $E_{SO_2} = 0.20$ lb/MBTU (70 ppm)

Run No. 1 - Boiler No. 2 - $E_{SO_2} = 0.18$ lb/MBTU (61 ppm)

Run No. 2 - Boiler No. 2 - $E_{SO_2} < 0.005$ - SAMPLE VOID *

Run No. 3 - Boiler No. 2 - $E_{SO_2} = 0.16$ lb/MBTU (57 ppm)

* PROBLEM IN SAMPLING TRAIN

EMISSIONS TEST REPORT - 1984

PINELLAS COUNTY

RESOURCE RECOVERY PLANT

Prepared For:

PINELLAS RESCO
3001 110TH AVENUE NORTH
ST. PETERSBURG, FLORIDA

Prepared By:

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.
5119 NORTH FLORIDA AVENUE
TAMPA, FLORIDA

June 28, 1984

I. SUMMARY

On May 21 and 22, 1984 Environmental Engineering Consultants, Inc. conducted emissions tests at the Pinellas County Resource Recovery Facility in St. Petersburg, Florida. The sources tested were two boilers burning municipal garbage to generate electricity. Particulate matter emission rates for FDER annual compliance certification were determined according to EPA Methods 1-5. Sulfur dioxide emission rates for FDER annual compliance certification were determined according to EPA Method 6. Opacity density for FDER annual certification was determined according to EPA Method 9.

The tests were conducted by Carl Fink and Jon Hull of Environmental Engineering Consultants, Inc. with the assistance and cooperation of Bill Whitman and the employees of UOP, Inc.

A summary of the test results is shown in Tables 1, 2, and 3. The average particulate emission concentrations corrected to 50% excess air were 0.0102 gr/dscf for Boiler No. 1 and 0.0165 gr/dscf for Boiler No. 2. The average sulfur dioxide emission rates wre 0.12 lb/MBTU for Boiler No. 1 and 0.13 lb/MBTU for Boiler No. 2. No visible emissions were observed during one-hour test periods on each boiler.

Each boiler was being operated at 100 ± 10% of its rated capacity during all test runs.

TABLE 1 - TEST SUMMATION

Plant: Pinellas County Resource Recovery

Source: Boiler No. 1

Test Date: May 21, 1984

Parameter: Particulate Matter

Run No.	DSCF	DSCFM	%H20	Ts °F	%ISO	Cs gr/dscf (50% EA)
1	49.994	100,746	15.15	477	103.3	0.0120
2	50.729	101,282	16.30	486	104.3	0.0101
3	49.159	99,362	15.98	493	103.0	0.0085
					Average	0.0102
					Allowable	0.08

TABLE 2 - TEST SUMMATION

Plant: Pinellas County Resource Recovery

Source: Boiler No. 2

Test Date: May 22, 1984

Parameter: Particulate Matter

Run No.	DSCF	DSCFM	%H20	Ts °F	%ISO	Cs gr/dscf (50% EA)
1	46.891	96,145	17.09	470	101.5	0.0204
2	47.340	96,568	17.17	473	102.1	0.0151
3	47.132	96,377	17.58	478	101.8	0.0141
					Average	0.0165
					Allowable	0.08

TABLE 3 - TEST SUMMATION

Plant: Pinellas County Resource Recovery

Parameter: Sulfur Dioxide

Boiler No. 1 5-21-84

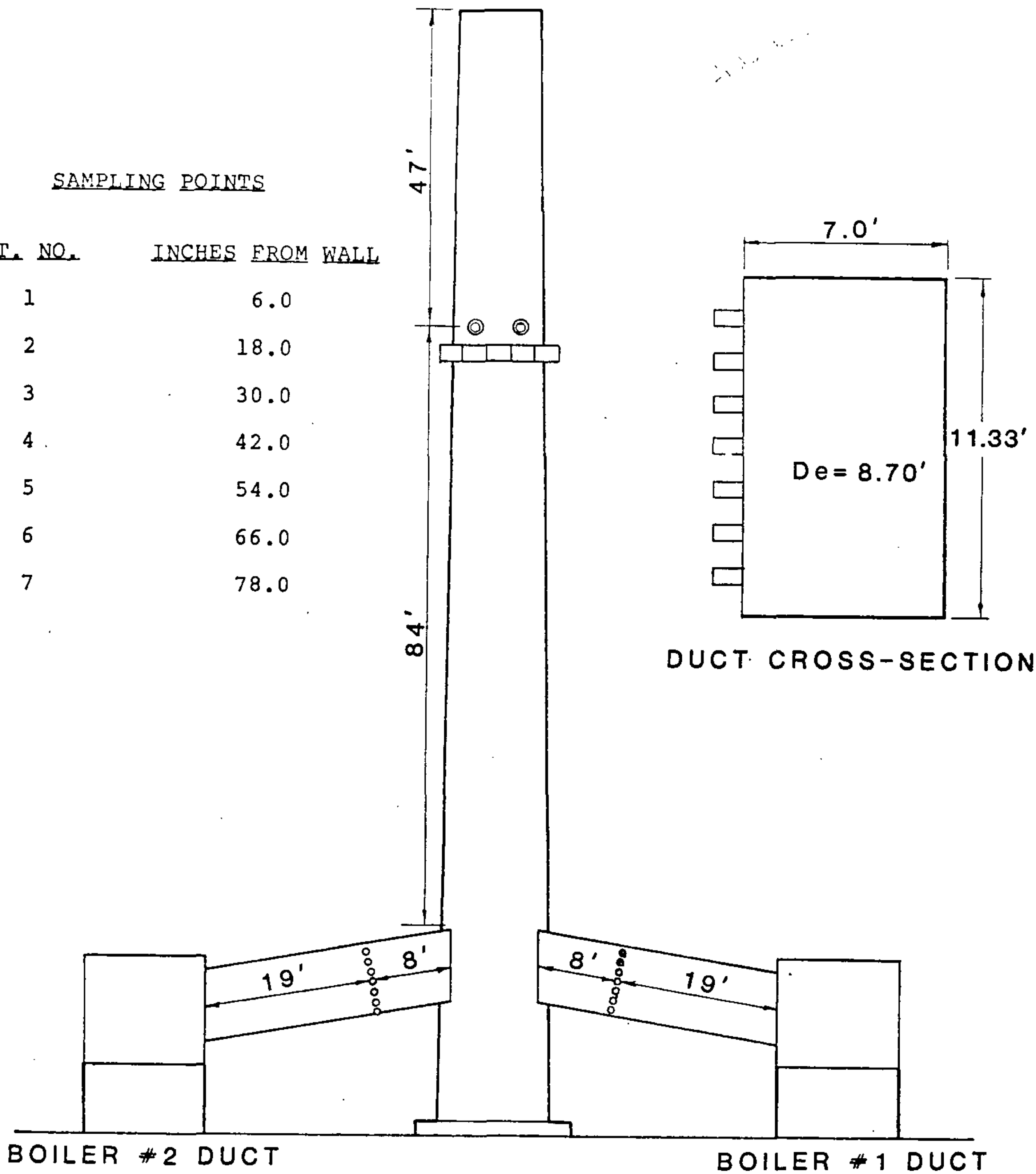
Run No.	Steam Flow, lb/hr	DSCFM	SO2, lb/hr	SO2, lb/MBTU
1	235,000	99,362	42.80	0.11
2	235,000	99,362	40.75	0.11
3	235,000	99,362	55.14	0.14
			Average	0.12
			Allowable	1.2

Boiler No. 2 5-22-84

Run No.	Steam Flow lb/hr	DSCFM	SO2, lb/hr	SO2, lb/MBTU
1	225,000	96,145	57.15	0.15
2	230,000	96,145	56.58	0.15
3	225,000	96,145	38.02	0.10
			Average	0.13
			Allowable	1.2

SAMPLING POINTS

PT. NO.	INCHES FROM WALL
1	6.0
2	18.0
3	30.0
4	42.0
5	54.0
6	66.0
7	78.0



TEST LOCATION DIMENSIONS

PINELLAS CO. RESOURCE RECOVERY PLANT

Figure 1

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

III. METHODS AND PROCEDURES

EPA Methods 1 and 2 were used to obtain the sampling point locations and determine stack velocity and volumetric flow rate, respectively. EPA Method 5 was followed for sampling and analysis of particulates. EPA Method 6 was used for sampling and analysis of sulfur dioxide.

SAMPLING

Particulate Matter

The Method 5 sampling train was assembled as shown in Figure 2 for each particulate test. A twelve foot probe with a heated pyrex glass liner was used for all test runs. The probe temperature measurements were conducted at each point during the initial velocity traverse and during sampling. An integrated gas sample was collected through a 1/4" stainless steel probe fixed to the particulate probe assembly.

The first and second impingers were each charged with 100 ml of distilled, deionized water; the third was dry; and the fourth was filled with known weight of indicator-grade silica gel. Crushed ice was placed around the impingers during sampling to maintain the temperature of the gas leaving the last impinger below 68 ^{o}F.

A borosilicate glass fiber filter (maintained at a temperature of 248 $\pm$ 25 ^{o}F) was used for particulate matter collection. The filter temperature was monitored throughout the test.

Leak tests were performed on the sampling train before and after each sampling run by blocking the nozzle inlet. No leakages were observed at vacuum levels at or exceeding those experienced during sampling. Pitot tube leak checks were also conducted at the end of each sampling run to validate the pressure readings.

Each sampling run consisted of 49 points, 7 points through each of the 7 ports. Each point was sampled for 2 minutes, giving a total test time of 98 minutes per run.

At the end of each run the volume of water collected in the first three impingers was measured and the silica gel in the fourth impinger was weighed to the nearest 0.5 gram to determine the volume of water collected. All impingers were then rinsed and charged for the next run.

The filter was removed to a clean dry petri dish for laboratory analysis. All components in the front half of the sampling train (sampling nozzle, probe liner, glass filter bell) were brushed and rinsed with acetone into a storage container; a new filter was installed and the sampling train reassembled for the next run.

<u>Sulfur Dioxide</u>

The Method 6 sampling train was assembled as shown in Figure 3 for each sulfur dioxide test. A heated six foot probe with a 1/4 inch diameter stainless steel liner was inserted about 3 feet into the duct through Port No. 3. The

ANALYSIS

Particulate Matter

The particulate filters for each run and one blank filter were oven dried at 105 ^{o}C for two hours, cooled in a desiccator, and weighed to constant weight. The acetone wash volumes were measured and transferred to tared 400 ml beakers and evaporated to dryness at low heat and ambient pressure. The beakers were then cooled in a desiccator and weighed to a constant weight. A portion of the acetone used for component washing was analyzed by the same procedure to determine blank residue.

Sulfur Dioxide

Sulfur dioxide concentrations were obtained using the barium thorin procedure as described in 40 CFR 60 Method 6. Sulfur dioxide analyses were performed by Interscience, Inc. under the direction of Dr. Thomas A. Jackman.

APPENDIX A

TEST DATA AND CALCULATIONS

SOURCE TESTING NOMENCLATURE AND DIMENSIONS

An: Cross sectional area of nozzle, ft2

As: Cross sectional area of stack, ft2

Bws: Water vapor in the gas stream, proportion by volume

Cs: Concentration of particulate matter in stack gas at the standard condition, gr/DSCF

Cs50: Concentration corrected to 50% excess air

Cs12: Concentration corrected to 12% carbon dioxide

Cp: Pitot tube coefficient

E: Source emission rate, lbs/hr

EA: Percent excess air

Md: Molecular weight of stack gas, dry basis, lb/lb-mole

Ms: Molecular weight of stack gas, wet basis, lb/lb-mole

Mn: Total particulate collected, less acetone and filter blank corrections; grams

Pb: Barometric pressure at test site, in Hg

Ps: Absolute stack gas pressure, mmHg

Qs: Volumetric flow rate, dry at standard conditions, SCFM

Tm: Absolute average dry gas meter temperature, ^{o}R

Ts: Absolute average stack gas temerature, ^{o}R

Vlc: Total volume of liquid collected in impingers and silica gel, ml

Vm: Volume of gas sampled under actual conditions, DCF

Vm(std): Volume of gas sampled corrected of standard conditions, DSCF

Vs: Stack gas velocity, ft/sec

Vw: Volume of water in sample corrected to standard conditions, SCF

Y: Dry gas meter calibration factor

θ: Total sampling time, min.

ΔP: Velocity head, in H_2O

ΔH: Average pressure differential acress orifice meter, in H_2O

SUMMARY OF TEST DATA

Plant: Pinellas County Resource Recovery Source: Boiler No.1

	Run 1	Run 2	Run 3
Date:	5-21-84	5-21-84	5-21-84
Time Interval:	0808-1009	1100-1256	1415-1608
Test Time, min.:	98	98	98
Steam Production, lb/hr:	235,000	235,000	235,000
Stack Area, Sq. ft.:	79.333	79.333	79.333
Nozzle Diameter, in.:	.267	.267	.267
Barometric Pressure, in. Hg.:	30.04	30.04	30.04
Absolute Stack Pressure, in. Hg.:	30.02	30.02	30.02
Volume Liquid Collected, ml:	189.5	209.7	198.5
Stack Gas Temperature, ^{o}F:	477	486	493
Stack Gas Moisture Content, %:	15.15	16.30	15.98
Sample Volume, DSCF:	49.994	50.729	49.159
Gas Velocity, FPS:	44.153	45.431	44.728
Gas Flowrate, ACFM:	210,169	216,248	212,904
Gas Flowrate, DSCFM:	100,746	101,282	99,362
Percent Isokinetic:	103.3	104.3	103.0
Percent CO2, Volume:	9.5	9.5	10.5
Percent O2, Volume:	9.9	10.3	9.1
Percent CO, Volume:	---	---	---
Percent N2, Volume:	80.6	80.2	80.4
Percent EA, Volume:	87.0	94.7	75.0
Particulate collected, grams:	0.0310	0.0256	0.0231
Concentration, gr/DSCF:	0.0096	0.0078	0.0073
Cs50, gr/DSCF:	0.0120	0.0101	0.0085
Cs12, gr/DSCF:	0.0121	0.0098	0.0083

SUMMARY OF TEST DATA

Plant: Pinellas County Resource Recovery   Source: Boiler No.2

	Run 1	Run 2	Run 3
Date:	5-22-84	5-22-84	5-22-84
Time Interval:	0854-1042	1152-1350	1444-1629
Test Time, min.:	98	98	98
Steam Production, lb/hr:	230,000	230,000	230,000
Stack Area, Sq. ft.:	79.333	79.333	79.333
Nozzle Diameter, in.:	.267	.267	.267
Barometric Pressure, in. Hg.:	30.07	30.07	30.07
Absolute Stack Pressure, in. Hg.:	30.05	30.05	30.05
Volume Liquid Collected, ml:	205.2	208.3	213.5
Stack Gas Temperature, °F:	470	473	478
Stack Gas Moisture Content, %:	17.09	17.17	17.58
Sample Volume, DSCF:	46.891	47.340	47.132
Gas Velocity, FPS:	42.758	43.127	43.487
Gas Flowrate, ACFM:	203,529	205,281	206,997
Gas Flowrate, DSCFM:	96,145	96,568	96,377
Percent Isokinetic:	101.5	102.1	101.8
Percent CO2, Volume: *	6.4	6.4	7.1
Percent O2, Volume: *	13.6	13.5	13.0
Percent CO, Volume:	---	---	---
Percent N2, Volume:	80.0	80.1	79.9
Percent EA, Volume:	180.9	176.6	160.6
Particulate collected, grams:	0.0322	0.0252	0.0248
Concentration, gr/DSCF:	0.0109	0.0082	0.0081
Cs50, gr/DSCF:	0.0204	0.0151	0.0141
Cs12, gr/DSCF:	0.0204	0.0154	0.0137

* Values not consistent with past data. See note on following page.

BOILER NO. 2 TEST DATA NOTE

Values for CO_2 and O_2 found during the testing were not consistent with past data from this source. Examination of the plant oxygen monitor data shows the values to be normal (between 7 and 9 percent) during the three test runs. The most probable cause for elevated O_2 readings was a leak in the gas sample collection system. The gas sample bags and the entire sampling train were leak checked in the laboratory before testing. The orsat analyzer was leak checked after each run but the collection system was not (leak checks are not mandatory).

Averaging gas composition values from all previous tests on Boiler No. 2 yields an average excess air factor of 90.1 percent. The average EA factor from the composition values as measured was 172.7 percent. Applying the more probable EA value to the particulate concentrations would result in a value of Cs_{50} = 0.0115 gr/dscf instead of Cs_{50} = 0.0165 gr/dscf.

SUMMARY OF TEST DATA

Plant: Pinellas County Resource Recovery

Parameter: Sulfur Dioxide

Boiler No. 1

	Run 1	Run 2	Run 3
Date:	5-21-84	5-21-84	5-21-84
Time Interval:	1734-1754	1819-1839	1851-1911
Steam Production, lb/hr:	235,000	235,000	235,000
Barometric Pressure, in. Hg.:	30.04	30.04	30.04
Gas Flowrate, DSCFM:	99,362	99,362	99,362
Sample Volume, DSCF:	0.609	0.627	0.644
SO2, lb/hr:	42.80	40.75	55.14
SO2, lb/MBTU:	0.11	0.11	0.14

Boiler No. 2

	Run 1	Run 2	Run 3
Date:	5-22-84	5-22-84	5-22-84
Time Interval:	0646-0706	0718-1738	0750-0810
Steam Production, lb/hr:	225,000	230,000	225,000
Barometric Pressure, in. Hg.:	30.07	30.07	30.07
Gas Flowrate, DSCFM:	96,145	96,145	96,145
Sample Volume, DSCF:	0.666	0.667	0.663
SO2, lb/hr:	57.15	56.58	38.02
SO2, lb/MBTU:	0.15	0.15	0.10

PLANT: Fineglas Co. Resource Recovery

SOURCE: Boiler No. 1

DATE: 5-21-84

RUN NO.: 1

CALIBRATION

C_p	0.84	
Y	1.005	
D_n	.267	in.
A_n	3.888×10^{-4}	ft^2

NEW DATA

P_b	30.04	in. Hg.
P_s	30.02	in. Hg.
A_s	79.333	ft^2
θ	98	min.
V_m	50.947	DCF
ΔH	.97	in. H_2O
T_m	544	°R
T_s	937	°R
V_{lc}	189.5	ml.
$(\sqrt{\Delta P})_{avg.}$	.5835	
M_n	.0310	g.

$$V_{m(std)} = \frac{17.64\, V_m Y\, (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(50.947)(1.005)(30.04 + \frac{.97}{13.6})}{(544)} = 49.9936 \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471\,(189.5) = 8.9255 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(8.9255)}{(8.9255) + (49.9936)} = 0.1515$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.5) + 0.32(9.9) + 0.28(80.6) = 29.916$$

$$M_s = M_d(1 - B_{ws}) + 18\, B_{ws} = (29.916)(.8485) + 18(.1515) = 28.1107$$

$$V_s = 85.49\, C_p\, (\sqrt{\Delta P})_{avg.} \left(T_s / P_s M_s\right)^{1/2} =$$

$$85.49(.84)(.5835)\left[\frac{(937)}{(30.02)(28.1107)}\right]^{1/2} = 44.1534 \text{ FPS}$$

$$Q_s = 1058\,(1 - B_{ws})\, V_s\, A_s\, (P_s / T_s) =$$

$$1058\,(.8485)(44.1534)(79.333)\frac{(30.02)}{(937)} = 100{,}746 \text{ SCFM}$$

(210,169 ACFM)

$$I = \frac{100\, V_{m(std)}\, A_s}{\theta\, Q_s\, A_n} = \frac{100\,(49.9936)(79.333)}{(98)(100{,}746)(3.888 \times 10^{-4})} = 103.3\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0310)}{(49.9936)} = 0.0096 \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(9.9) - .5(0) \times 100}{.264(80.6) - [(9.9) - .5(0)]} = 87.0\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$$C_{s_{50}} = 0.0120 \text{ gr/dscf}$$

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$$C_{s_{12}} = 0.0121 \text{ gr/dscf}$$

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT Pinellas Co. Resource Recovery

SOURCE Boiler No. 1

DATE 5-21-84

RUN NO. 2

CALIBRATION

C_p	0.84	
Y	1.005	
D_n	.267	in.
A_n	3.888×10^{-4}	ft^2

NEW DATA

P_b	30.04	in. Hg
P_s	30.02	in. Hg
A_s	79.333	ft^2
θ	98	min.
V_m	52.358	DCF
ΔH	1.00	in. H_2O
T_m	551	°R
T_s	946	°R
V_{lc}	209.7	ml
$(\sqrt{\Delta P})_{avg.}$	.5962	
M_n	0.0256	g.

$$V_{m(std)} = \frac{17.64\ V_m Y\ (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(52.358)(1.005)(30.04 + \frac{1.00}{13.6})}{(551)} = \underline{50.7292}\ \text{DSCF}$$

$$V_w = 0.0471\ V_{lc} = 0.0471(209.7) = \underline{9.8769}\ \text{SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.8769)}{(9.8769) + (50.7292)} = \underline{0.1630}$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.5) + 0.32(10.3) + 0.28(80.2) = \underline{29.932}$$

$$M_s = M_d(1 - B_{ws}) + 18 B_{ws} = (29.932)(.8370) + 18(.1630) = \underline{27.9871}$$

$$V_s = 85.49\ C_p\ (\sqrt{\Delta P})_{avg.}\ (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.5962)\left[\frac{(946)}{(30.02)(27.9871)}\right]^{1/2} = \underline{45.4305}\ \text{FPS}$$

$$Q_s = 1058\ (1 - B_{ws})\ V_s\ A_s\ (P_s / T_s) =$$

$$1058\ (.8370)(45.4305)(79.333)\frac{(30.02)}{(946)} = \underline{101,282}\ \text{SCFM}$$

(216,248 ACFM)

$$I = \frac{100\ V_{m(std)}\ A_s}{\theta\ Q_s\ A_n} = \frac{100(50.7292)(79.333)}{(98)(101,282)(3.888 \times 10^{-4})} = \underline{104.3}\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0256)}{(50.7292)} = \underline{0.0078}\ \text{gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(10.3) - .5(0) \times 100}{.264(80.2) - [(10.3) - .5(0)]} = \underline{94.7}\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$C_{s_{50}}$ = 0.0101 gr/dscf

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$C_{s_{12}}$ = 0.0098 gr/dscf

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT: PINELLAS CO. RESOURCE RECOVERY

SOURCE: BOILER NO. 1

DATE: 5-21-84

RUN NO.: 3

CALIBRATION

C_p	0.84	
Y	1.005	
D_n	.267	in.
A_n	3.888×10^{-4}	ft^2

NEW DATA

P_b	30.04	in. Hg.
P_s	30.02	in. Hg.
A_s	79.333	ft^2
θ	98	min.
V_m	51.754	DCF
ΔH	.97	in. H_2O
T_m	562	°R
T_s	953	°R
V_{lc}	198.5	ml
$(\sqrt{\Delta P})_{avg.}$	.5862	
M_n	.0231	g.

$$V_{m(std)} = \frac{17.64\, V_m Y \left(P_b + \Delta H/13.6\right)}{T_m} =$$

$$\frac{17.64(51.754)(1.005)(30.04 + \frac{.97}{13.6})}{(562)} = \underline{49.1589}\ \text{DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471(198.5) = \underline{9.3494}\ \text{SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.3494)}{(9.3494)+(49.1589)} = \underline{0.1598}$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(10.5) + 0.32(9.1) + 0.28(80.4) = \underline{30.0440}$$

$$M_s = M_d(1-B_{ws}) + 18B_{ws} = (30.044)(.8402) + 18(.1598) = \underline{28.1194}$$

$$V_s = 85.49\, C_p (\sqrt{\Delta P})_{avg.} \left(T_s / P_s M_s\right)^{1/2} =$$

$$85.49(.84)(.5862)\left[\frac{(953)}{(30.02)(28.1194)}\right]^{1/2} = \underline{44.7279}\ \text{FPS}$$

$$Q_s = 1058(1-B_{ws})\, V_s\, A_s\, (P_s/T_s) =$$

$$1058(.8402)(44.7279)(79.333)\frac{(30.02)}{(953)} = \underline{99{,}362}\ \text{SCFM}$$

(212,904 ACFM)

$$I = \frac{100\, V_{m(std)}\, A_s}{\theta\, Q_s\, A_n} = \frac{100(49.1589)(79.333)}{(98)(99{,}362)(3.888\times10^{-4})} = \underline{103.0}\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0231)}{(49.1589)} = \underline{0.0073}\ \text{gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(9.1) - .5(0) \times 100}{.264(80.4) - [(9.1) - .5(0)]} = \underline{75.0}\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$$C_{s_{50}} = \underline{0.0085}\ \text{gr/dscf}$$

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$$C_{s_{12}} = \underline{0.0083}\ \text{gr/dscf}$$

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT: Pinellas Co. Resource Recovery

SOURCE: Boiler No. 1

DATE: 5-21-84

RUN NO.: SO_2

FLOW RATE

C_p	0.84	
Y	1.005	
P_b	30.04	in. Hg
P_s	30.02	in. Hg
A_s	79.333	ft²
V_m	51.754	DCF
ΔH	.97	in. H_2O
T_m	562	°R
T_s	953	°R
V_{lc}	198.5	ml
$(\sqrt{\Delta P})_{avg}$	.5862	

SO_2

Y	0.978	
K	7.061×10^{-5}	lb/meq.
V_m	0.652	DCF
T_m	555	°R
P_b	30.04	in Hg
SO_2	0.0619	meq.

$$V_{m(std)} = \frac{17.64\, V_m Y\, (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64\,(51.754)(1.005)(30.04 + \frac{.97}{13.6})}{(562)} = 49.1589 \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471\,(198.5) = 9.3494 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.3494)}{(9.3494) + (49.1589)} = 0.1598$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(10.5) + 0.32(9.1) + 0.28(80.4) = 30.0440$$

$$M_s = M_d(1 - B_{ws}) + 18\,B_{ws} = (30.0440)(.8402) + 18(.1598) = 28.1194$$

$$V_s = 85.49\, C_p\, (\sqrt{\Delta P})_{avg.} \left(T_s / P_s M_s \right)^{1/2} =$$

$$85.49(.84)(.5862)\left[\frac{(953)}{(30.02)(28.1194)}\right]^{1/2} = 44.7279 \text{ FPS}$$

$$Q_s = 1058\,(1 - B_{ws})\, V_s\, A_s\, (P_s / T_s) =$$

$$1058\,(.8402)(44.7279)(79.333)\frac{(30.02)}{(953)} = 99{,}362 \text{ SCFM}$$

$$V_{m(std)} = 17.64\,\frac{V_m Y P_b}{T_m} = \frac{(17.64)(.652)(.978)(30.04)}{(555)} = 0.6088 \text{ DSCF}$$

$$C_{SO_2} = K\,\frac{(SO_2)}{(V_{m\,std})} = (7.061 \times 10^{-5})\frac{(.0619)}{(.6088)} = 7.179 \times 10^{-6}$$

$$E_{SO_2} = C_s Q_s (60) = (\quad)(\quad)(60) = 42.80 \text{ lb/hr}$$

SAMPLE CALCULATION

ESO_2 VALUES

#1	42.80	lb/hr
#2	40.75	lb/hr
#3	55.14	lb/hr
AVG.		lb/hr

SO_2 SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT Anchlas Co. Resource Recovery

SOURCE Boiler No. 2

DATE 5-22-84

RUN NO. 1

CALIBRATION

C_p	0.84	
Y	1.005	
D_n	.267	in.
A_n	3.888×10^{-4}	ft^2

NEW DATA

P_b	30.07	in. Hg
P_s	30.05	in. Hg
A_s	79.333	ft^2
θ	98	min.
V_m	48.189	DCF
ΔH	.86	in. H_2O
T_m	549	°R
T_s	930	°R
V_{lc}	205.2	ml
$(\sqrt{\Delta P})_{avg.}$	.5622	
M_n	0.0332	g.

$$V_{m(std)} = \frac{17.64\ V_m Y\ (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(48.189)(1.005)(30.07 + \frac{.86}{13.6})}{(549)} = \underline{46.8906} \text{ DSCF}$$

$$V_w = 0.0471\ V_{lc} = 0.0471(205.2) = \underline{9.6649} \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.6649)}{(9.6649)+(46.8906)} = \underline{0.1709}$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(6.4) + 0.32(13.6) + 0.28(80.0) = \underline{29.568}$$

$$M_s = M_d(1-B_{ws}) + 18\,B_{ws} = (29.568)(.8291) + 18(.1709) = \underline{27.5910}$$

$$V_s = 85.49\ C_p\ (\sqrt{\Delta P})_{avg.}\left(T_s / P_s M_s\right)^{1/2} =$$

$$85.49(.84)(.5622)\left[\frac{(930)}{(30.05)(27.5910)}\right]^{1/2} = \underline{42.7584} \text{ FPS}$$

$$Q_s = 1058\,(1-B_{ws})\ V_s\ A_s\ (P_s/T_s) =$$

$$1058\,(.8291)(42.7584)(79.333)\frac{(30.05)}{(930)} = \underline{96,145} \text{ SCFM}$$

(203,529 ACFM)

$$I = \frac{100\ V_{m(std)}\ A_s}{\theta\ Q_s\ A_n} = \frac{100\,(46.8906)(79.333)}{(98)(96,145)(3.888 \times 10^{-4})} = \underline{101.5}\ \%$$

$$C_s = 15.43\frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0332)}{(46.8906)} = \underline{0.0109} \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(13.6) - .5(0) \times 100}{.264(80.0) - [(13.6) - .5(0)]} = \underline{180.9}\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$C_{s_{50}}$ = 0.0204 gr/dscf

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$C_{s_{12}}$ = 0.0204 gr/dscf

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT: PINELLAS CO. RESOURCE RECOVERY

SOURCE: BOILER NO 2

DATE: 5-22-84

RUN NO. 2

CALIBRATION

C_p	.84	
Y	1.005	
D_n	.267	in.
A_n	3.888×10^{-4}	ft^2

NEW DATA

P_b	30.07	in. Hg.
P_s	30.05	in. Hg.
A_s	79.333	ft^2
θ	98	min.
V_m	48.914	DCF
ΔH	.88	in. H_2O
T_m	552	°R
T_s	933	°R
V_{lc}	208.3	ml
$(\sqrt{\Delta P})_{avg.}$	.5660	
M_n	.0252	g.

$$V_{m(std)} = \frac{17.64\, V_m Y\,(P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(48.914)(1.005)(30.07 + \frac{.88}{13.6})}{(552)} = 47.3397 \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471(208.3) = 9.8109 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.8109)}{(9.8109)+(47.3397)} = .1717$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(6.4) + 0.32(13.5) + 0.28(80.1) = 29.564$$

$$M_s = M_d(1 - B_{ws}) + 18 B_{ws} = (29.564)(.8283) + 18(.1717) = 27.5785$$

$$V_s = 85.49\, C_p (\sqrt{\Delta P})_{avg.} (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.5660)\left[\frac{(933)}{(30.05)(27.5785)}\right]^{1/2} = 43.1265 \text{ FPS}$$

$$Q_s = 1058(1 - B_{ws}) V_s A_s (P_s / T_s) =$$

$$1058(.8283)(43.1265)(79.333)\frac{(30.05)}{(933)} = 96{,}568 \text{ SCFM}$$

(205,281 ACFM)

$$I = \frac{100\, V_{m(std)} A_s}{\theta\, Q_s A_n} = \frac{100(47.3397)(79.333)}{(98)(96{,}568)(3.888 \times 10^{-4})} = 102.1\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0252)}{(47.3397)} = 0.0082 \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(13.5) - .5(0) \times 100}{.264(80.1) - [(13.5) - .5(0)]} = 176.6\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$$C_{s_{50}} = 0.0151 \text{ gr/dscf}$$

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$$C_{s_{12}} = 0.0154 \text{ gr/dscf}$$

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT Pinellas Co. Resource Recovery

SOURCE Boiler No. 2

DATE 5-22-84

RUN NO. 3

CALIBRATION

C_p 0.84

Y 1.005

D_n .267 in.

A_n 3.888×10^{-4} ft²

NEW DATA

P_b 30.07 in. Hg

P_s 30.05 in. Hg

A_s 79.333 ft²

θ 98 min.

V_m 49.316 DCF

ΔH .89 in. H₂O

T_m 559 °R

T_s 938 °R

V_{lc} 213.5 ml

$(\sqrt{\Delta P})_{avg.}$ .5695

M_n .0248 g.

$$V_{m(std)} = \frac{17.64\, V_m Y \left(P_b + \Delta H/13.6\right)}{T_m} =$$

$$\frac{17.64(49.316)(1.005)(30.07 + \frac{.89}{13.6})}{(559)} = 47.1323 \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471(213.5) = 10.0559 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(10.0559)}{(10.0559)+(47.1323)} = 0.1758$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(7.1) + 0.32(13.0) + 0.28(79.9) = 29.656$$

$$M_s = M_d(1-B_{ws}) + 18B_{ws} = (29.656)(.8242) + 18(.1758) = 27.6069$$

$$V_s = 85.49\, C_p (\sqrt{\Delta P})_{avg.} \left(T_s / P_s M_s\right)^{1/2} =$$

$$85.49(.84)(.5695)\left[\frac{(938)}{(30.05)(27.6069)}\right]^{1/2} = 43.4869 \text{ FPS}$$

$$Q_s = 1058(1-B_{ws}) V_s A_s (P_s/T_s) =$$

$$1058(.8242)(43.4869)(79.333)\frac{(30.05)}{(938)} = 96{,}377 \text{ SCFM}$$

(206,997 ACFM)

$$I = \frac{100\, V_{m(std)} A_s}{\theta\, Q_s\, A_n} = \frac{100(47.1323)(79.333)}{(98)(96{,}377)(3.888\times10^{-4})} = 101.8\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0248)}{(47.1323)} = 0.0081 \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(13.0) - .5(0) \times 100}{.264(79.9) - [(13.0) - .5(0)]} = 160.6\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$C_{s_{50}}$ = 0.0141 gr/dscf

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$C_{s_{12}}$ = 0.0137 gr/dscf

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT Pinellas Co. Resource Recovery

SOURCE Boiler No 2

DATE 5-22-84

RUN NO. SO_2

FLOWRATE

C_P 0.84

Y 1.005

P_b 30.07 in. Hg

P_s 30.05 in. Hg

A_s 79.333 ft²

V_m 48.189 DCF

ΔH .86 in. H₂O

T_m 549 °R

T_s 930 °R

V_{lc} 205.2 ml

$(\sqrt{\Delta P})_{avg}$ .5622

SO_2

Y 0.978

K 7.061×10^{-5} lb/meq.

V_m 0.691 DCF

T_m 538.5 °R

P_b 30.07 in Hg

SO_2 0.0934 meq.

$$V_{m(std)} = \frac{17.64\ V_m Y\ (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(48.189)(1.005)(30.07 + \frac{.86}{13.6})}{(549)} = 46.8906 \text{ DSCF}$$

$$V_w = 0.0471\ V_{lc} = 0.0471(205.2) = 9.6649 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(9.6649)}{(9.6649)+(46.8906)} = 0.1709$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(6.4) + 0.32(13.6) + 0.28(80.0) = 29.568$$

$$M_s = M_d(1-B_{ws}) + 18 B_{ws} = (29.568)(.8291) + 18(.1709) = 27.5910$$

$$V_s = 85.49\ C_p\ (\sqrt{\Delta P})_{avg.} (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.5622)\left[\frac{(930)}{(30.05)(27.5910)}\right]^{1/2} = 42.7584 \text{ FPS}$$

$$Q_s = 1058 (1-B_{ws})\ V_s\ A_s\ (P_s/T_s) =$$

$$1058(.8291)(42.7584)(79.333)\frac{(30.05)}{(930)} = 96,145 \text{ SCFM}$$

$$V_{m(std)} = 17.64 \frac{V_m Y P_b}{T_m} = \frac{(17.64)(.691)(.978)(30.07)}{(538.5)} = 0.6657 \text{ DSCF}$$

$$C_{SO_2} = K \frac{(SO_2)}{(V_{m\,std})} = (7.061 \times 10^{-5})\frac{(.0934)}{(.6657)} = 9.907 \times 10^{-6}$$

$$E_{SO_2} = C_s Q_s (60) = (\quad)(\quad)(60) = 57.15 \text{ lb/hr}$$

SAMPLE CALCULATION

ESO_2 VALUES

#1	57.15	lb/hr
#2	56.58	lb/hr
#3	38.02	lb/hr
AVG.		lb/hr

SO_2 SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

Interscience, Inc.
5025 W. Grace St. Tampa, FL 33607
(813) 879-8611

June 25, 1984

Environmental Engineering Consultants
P.O. Box 7854
Tampa, Florida 33673

Attn: Mr. Carl Fink

Re: Project Number: 84018-20
Analysis of Source Test Samples for SO_2
Sample Numbers: 84-05-263 through 84-05-269

METHODOLOGY

The samples were analyzed using the analytical protocol cited in USEPA Method 6 - Determination of Sulfur Dioxide Emissions from Stationary Sources.

RESULTS

Sample Number	Sample I.D.	SO_2, milliequivalents
84-05-263	Boiler 1 #1	0.0619
84-05-264	Boiler 1 #2	0.0607
84-05-265	Boiler 1 #3	0.0844
84-05-266	Boiler 2 #1	0.0934
84-05-267	Boiler 2 #2	0.0926
84-05-268	Boiler 2 #3	0.0619
84-05-269	6% H_2O_2 Blank	0.0000

If you have any questions concerning this report, please do not hesitate to contact me.

Interscience, Inc. operates as an independent contractor and does not guarantee any particular results other than its best efforts.

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Respectfully submitted,

INTERSCIENCE, INC.

Thomas A. Jackman, Ph.D.
Laboratory Director

TAJ:cao

EMISSIONS TEST REPORT

PINELLAS COUNTY

RESOURCE RECOVERY PLANT

MAY 1 AND 2, 1985

Prepared For:

PINELLAS RESCO
3001 110TH AVENUE NORTH
ST. PETERSBURG, FLORIDA

Prepared By:

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.
5119 NORTH FLORIDA AVENUE
TAMPA, FLORIDA

May 31, 1985

I. SUMMARY

On May 1 and 2, 1985, Environmental Engineering Consultants, Inc. conducted emissions tests at the Pinellas County Resource Recovery Facility in St. Petersburg, Florida. The sources tested were two boilers burning municipal garbage to generate electricity. Particulate matter emission rates for FDER annual compliance certification were determined according to EPA Methods 1-5. Sulfur dioxide emission rates for FDER annual compliance certification were determined according to EPA Method 6. Opacity density for FDER annual certification was determined according to EPA Method 9.

The tests were conducted by Carl Fink, Jon Hull and Byron Burrows of Environmental Engineering Consultants, Inc. with the assistance and cooperation of Mary Weiland and the employees of Pinellas Resco, Inc.

A summary of the test results is shown in Tables 1, 2, and 3. The average particulate emission concentrations corrected to 50% excess air were 0.0155 gr/dscf for Boiler No. 1 and 0.0288 gr/dscf for Boiler No. 2. The average sulfur dioxide emission rates were 0.08 lb/MBTU for Boiler No. 1 and 0.07 lb/MBTU for Boiler No. 2. No visible emissions were observed during one-hour test periods on each boiler.

Each boiler was being operated at 100 ± 10% of its rated capacity during all test runs.

TABLE 1

TEST SUMMATION

PLANT: Pinellas County Resource Recovery

SOURCE: Boiler No. 1

DATE: May 1, 1985

PARAMETER: Particulate Matter

Run No.	Sample Vol. (DSCF)	Flow Rate (DSCFM)	Moisture (%)	Stack Temp. (^oF)	Isokinetics (%)	Particulate Concentration (gr/dscf @ 50% EA)
1	39.819	114,012	15.15	492	101.8	0.0194
2	38.716	113,285	14.28	498	99.6	0.0139
3	38.746	111,562	13.48	500	101.2	0.0133
Average		112,953	14.30	497	100.9	0.0155
					Allowable	0.08

TABLE 2

TEST SUMMATION

PLANT: Pinellas County Resource Recovery

SOURCE: Boiler No. 2

DATE: May 2, 1985

PARAMETER: Particulate Matter

Run No.	Sample Vol. (DSCF)	Flow Rate (DSCFM)	Moisture (%)	Stack Temp. (^{o}F)	Isokinetics (%)	Particulate Concentration (gr/dscf @ 50% EA)
1	44.231	129,321	12.62	532	99.8	0.0276
2	44.140	124,383	13.92	538	103.4	0.0217
3	44.465	123,512	16.19	542	104.9	0.0370
Average		125,709	14.24	537	102.7	0.0288
					Allowable	0.08

TABLE 3 - TEST SUMMATION

PLANT: Pinellas County Resource Recovery

PARAMETER: Sulfur Dioxide

Boiler No. 1 5-1-85

Run No.	Steam Flow (lb/hr)	Flow Rate (DSCFM)	Sulfur Dioxide Emissions (lb/hr)		Sulfur Dioxide Emissions (lb/MBTU)
1	246,000	111,562	29.40		0.07
2	246,000	111,562	33.04		0.08
3	249,000	111,562	35.60		0.09
				Average	0.08
				Allowable	1.2

Boiler No. 2 5-2-85

Run No.	Steam Flow (lb/hr)	Flow Rate (DSCFM)	Sulfur Dioxide Emissions (lb/hr)		Sulfur Dioxide Emissions (lb/MBTU)
1	246,000	129,231	30.66		0.08
2	246,000	124,383	28.49		0.07
3	246,000	123,512	23.99		0.06
				Average	0.07
				Allowable	1.2

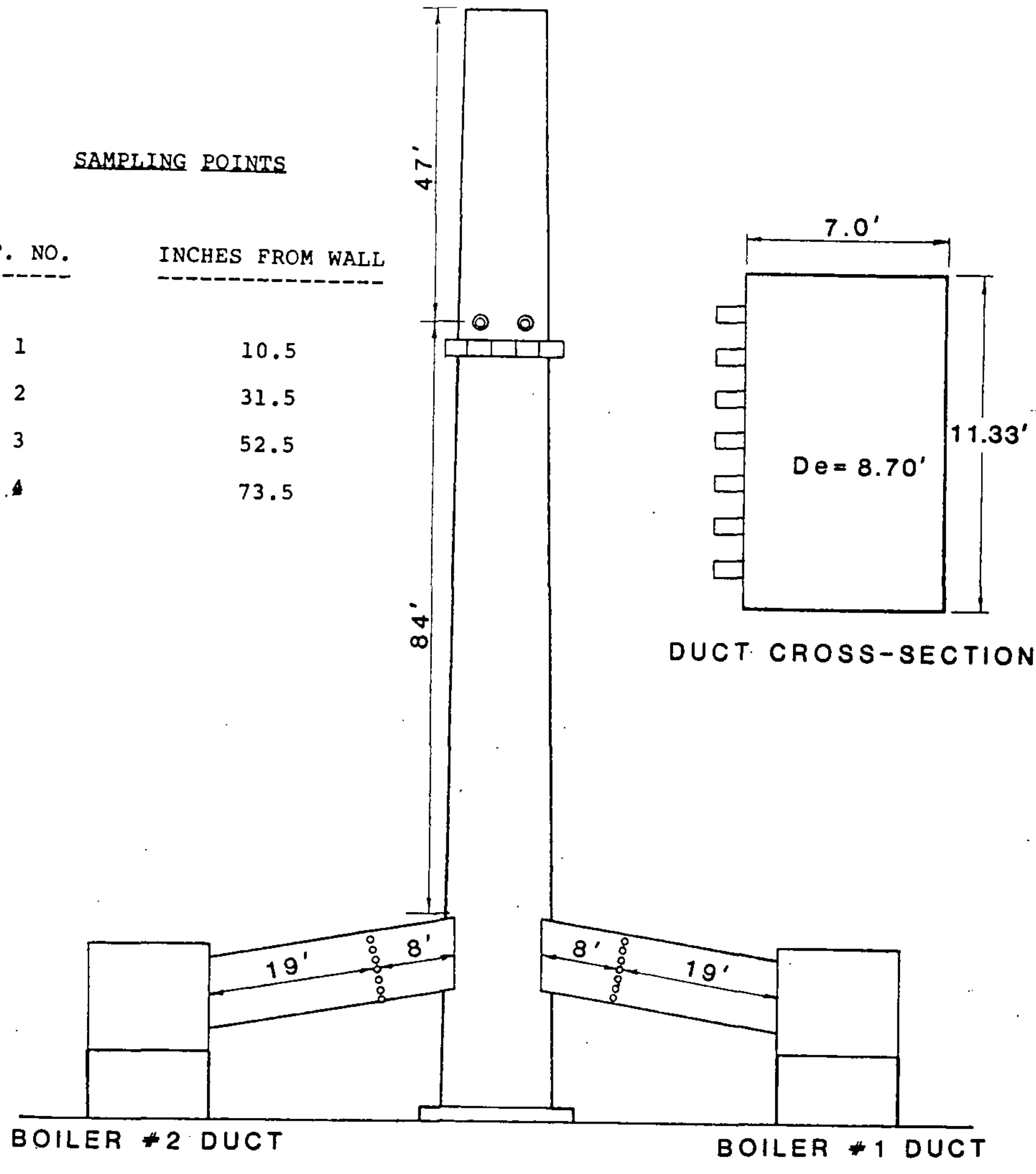
II. SOURCE DESCRIPTION

The Pinellas County Resource Recovery Facility consists of two solid waste fired boilers, burning municipal garbage, that produce steam which is used to generate up to 50MW of electricity. Residual ash is processed to remove recoverable metals and transported to an adjacent landfill.

The exhaust gas from each boiler passes through an electrostatic precipitator before being vented through a 7 ft x 11.33 ft square duct into a common stack 161 feet tall (See Figure 1). The sampling ports are located in the ducts leading to the stack at a point 0.9 diameters upstream and 2.2 diameters downstream from disturbances in the exhaust flow.

SAMPLING POINTS

PT. NO.	INCHES FROM WALL
1	10.5
2	31.5
3	52.5
4	73.5



DUCT CROSS-SECTION

TEST LOCATION DIMENSIONS

PINELLAS CO. RESOURCE RECOVERY PLANT

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

Figure 1

SUMMARY OF TEST DATA

Plant: Pinellas County Resource Recovery Source: Boiler No.1

	Run 1	Run 2	Run 3
Date:	5-1-85	5-1-85	5-1-85
Time Interval:	0911-1112	1300-1440	1527-1657
Test Time, min.:	70	70	70
Steam Production, lb/hr:	245,000	245,000	245,000
Stack Area, Sq. ft.:	79.333	79.333	79.333
Nozzle Diameter, in.:	.267	.267	.267
Barometric Pressure, in. Hg.:	30.05	30.02	29.98
Absolute Stack Pressure, in. Hg.:	30.04	30.01	29.97
Volume Liquid Collected, ml:	150.9	136.9	128.2
Stack Gas Temperature, °F:	492	498	500
Stack Gas Moisture Content, %:	15.15	14.28	13.48
Sample Volume, DSCF:	39.819	38.716	38.746
Gas Velocity, FPS:	50.734	50.263	49.209
Gas Flowrate, ACFM:	241,491	239,251	234,235
Gas Flowrate, DSCFM:	114,012	113,285	111,562
Percent Isokinetic:	101.8	99.6	101.2
Percent CO_2, Volume:	10.0	10.0	9.9
Percent O_2, Volume:	9.7	9.6	9.8
Percent CO, Volume:	---	---	---
Percent N_2, Volume:	80.3	80.4	80.3
Percent EA, Volume:	84.4	82.6	86.0
Particulate collected, grams:	0.0408	0.0287	0.0270
Concentration, gr/DSCF:	0.0158	0.0114	0.0108
Cs50, gr/DSCF:	0.0194	0.0139	0.0133

SUMMARY OF TEST DATA

Plant: Pinellas County Resource Recovery   Source: Boiler No.2

	Run 1	Run 2	Run 3
Date:	5-2-85	5-2-85	5-2-85
Time Interval:	0914-1043	1159-1326	1426-1554
Test Time, min.:	70	70	70
Steam Production, lb/hr:	245,000	245,000	240,000
Stack Area, Sq. ft.:	79.333	79.333	79.333
Nozzle Diameter, in.:	.267	.267	.267
Barometric Pressure, in. Hg.:	30.00	30.00	29.95
Absolute Stack Pressure, in. Hg.:	30.00	30.00	29.95
Volume Liquid Collected, ml:	135.6	151.5	182.3
Stack Gas Temperature, ^{o}F:	532	538	542
Stack Gas Moisture Content, %:	12.62	13.92	16.19
Sample Volume, DSCF:	44.231	44.140	44.465
Gas Velocity, FPS:	58.265	57.270	58.742
Gas Flowrate, ACFM:	277,339	272,605	279,608
Gas Flowrate, DSCFM:	129,231	124,383	123,512
Percent Isokinetic:	99.8	103.4	104.9
Percent CO2, Volume:	8.9	9.2	9.4
Percent O2, Volume:	10.6	10.4	10.4
Percent CO, Volume:	---	---	---
Percent N2, Volume:	80.5	80.4	80.2
Percent EA, Volume:	99.4	96.1	96.5
Particulate collected, grams:	0.0594	0.0474	0.0814
Concentration, gr/DSCF:	0.0207	0.0166	0.0282
Cs50, gr/DSCF:	0.0276	0.0217	0.0370

SUMMARY OF TEST DATA

Plant: Pinellas County Resource Recovery

Parameter: Sulfur Dioxide

Boiler No. 1 May 1, 1985

	Run 1	Run 2	Run 3
Time Interval:	1735-1755	1804-1824	1832-1854
Steam Production, lb/hr:	246,000	246,000	249,000
Heat Input, BTU/lb steam:	1654	1654	1654
Heat Input MMBTU/hr:	406.88	406.88	411.85
Barometric Pressure, in. Hg.:	29.96	29.96	29.96
Gas Flowrate, DSCFM:	111,562	111,562	111,562
Sample Volume, DSCF:	0.611	0.701	0.704
SO2, meq:	0.038	0.049	0.053
SO2, lb/hr:	29.40	33.04	35.60
SO2, lb/MBTU:	0.07	0.08	0.09

Boiler No. 2 May 2, 1985

	Run 1	Run 2	Run 3
Time Interval:	0831-0851	1108-1128	1343-1403
Steam Production, lb/hr:	246,000	246,000	246,000
Heat Input, BTU/lb steam:	1656	1656	1656
Heat Input, MBTU/hr:	407.38	407.38	407.38
Barometric Pressure, in. Hg.:	30.00	30.00	29.95
Gas Flowrate, DSCFM:	129,231	124,383	123,512
Sample Volume, DSCF:	0.696	0.684	0.676
SO2, meq:	0.039	0.037	0.031
SO2, lb/hr:	30.66	28.49	23.99
SO2, lb/MBTU:	0.08	0.07	0.06

PLANT Pinellas RESCO

SOURCE Boiler No. 1

DATE 5-1-85

RUN NO. 1

CALIBRATION

C_p 0.84

Y_m 0.989

D_n .267 in.

A_n 3.8882×10^{-4} ft^2

NEW DATA

P_b 30.05 in. Hg.

P_s 30.04 in. Hg

A_s 79.333 ft^2

θ 70 min.

V_m 40.975 DCF

ΔH 1.16 in. H_2O

T_m 541 °R

T_s 952 °R

V_{lc} 150.9 ml

$(\sqrt{\Delta P})_{avg.}$ .6661

M_n 0.0408 g.

$$V_{m(std)} = \frac{17.64\ V_m Y\ (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(40.975)(.989)(30.05 + \frac{1.16}{13.6})}{(541)} = 39.8192 \text{ DSCF}$$

$$V_w = 0.0471\ V_{lc} = 0.0471\ (150.9) = 7.1074 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(7.1074)}{(7.1074) + (39.8192)} = 0.1515$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(10.0) + 0.32(9.7) + 0.28(80.3) = 29.988$$

$$M_s = M_d(1 - B_{ws}) + 18\ B_{ws} = (29.988)(.8485) + 18(.1515) = 28.1718$$

$$V_s = 85.49\ C_p\ (\sqrt{\Delta P})_{avg.}\ (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.6661)\left[\frac{(952)}{(30.04)(28.1718)}\right]^{1/2} = 50.7335 \text{ FPS}$$

$$Q_s = 1058\ (1 - B_{ws})\ V_s\ A_s\ (P_s / T_s) =$$

$$1058\ (.8485)(50.7335)(79.333)\frac{(30.04)}{(952)} = 114{,}012 \text{ DSCFM}$$

241,491 ACFM

$$I = \frac{100\ V_{m(std)}\ A_s}{\theta\ Q_s\ A_n} = \frac{100\ (39.8192)(79.333)}{(70)(114{,}012)(3.8882 \times 10^{-4})} = 101.8\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0408)}{(39.8192)} = 0.0158\ gr/SCF$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(9.7) - .5(0.0) \times 100}{.264(80.3) - [(9.7) - .5(0)]} = 84.35\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$C_{s_{50}}$ = 0.0194 gr/dscf

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$C_{s_{12}}$ = ______ gr/dscf

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT: ANELLAS RESCO

SOURCE: BOILER NO. 1

DATE: 5-1-85

RUN NO.: 2

CALIBRATION

C_p	0.84
Y	0.989
D_n	.267 in.
A_n	3.8882×10^{-4} ft²

NEW DATA

P_b	30.02 in. Hg
P_s	30.01 in. Hg
A_s	79.333 ft²
θ	70 min.
V_m	40.840 DCF
ΔH	1.14 in. H_2O
T_m	554 °R
T_s	958 °R
V_{lc}	136.9 ml
$(\sqrt{\Delta P})_{avg.}$	.6587
M_n	0.0287 g.

$$V_{m(std)} = \frac{17.64\, V_m Y\, (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(40.840)(.989)(30.02 + \frac{1.14}{13.6})}{(554)} = \underline{38.7162} \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471(136.9) = \underline{6.4480} \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(\quad)}{(\quad) + (38.7162)} = \underline{0.1428}$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(10.0) + 0.32(9.6) + 0.28(80.4) = \underline{29.984}$$

$$M_s = M_d(1 - B_{ws}) + 18\, B_{ws} = (29.984)(.8572) + 18(.1428) = \underline{28.2727}$$

$$V_s = 85.49\, C_p\, (\sqrt{\Delta P})_{avg.}\, (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.6587)\left[\frac{(958)}{(30.01)(28.2727)}\right]^{1/2} = \underline{50.2630} \text{ FPS}$$

$$Q_s = 1058\,(1 - B_{ws})\, V_s\, A_s\, (P_s / T_s) =$$

$$1058(.8572)(50.2630)(79.333)\frac{(30.01)}{(958)} = \underline{113,285} \text{ DSCFM}$$

239,251 ACFM

$$I = \frac{100\, V_{m(std)}\, A_s}{\theta\, Q_s\, A_n} = \frac{100(38.7162)(79.333)}{(70)(113,285)(3.8882 \times 10^{-4})} = \underline{99.6}\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0287)}{(38.7162)} = \underline{0.0114} \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(9.6) - .5(0) \times 100}{.264(80.4) - [(9.6) - .5(0)]} = \underline{82.58}\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$C_{s_{50}} = \underline{0.0139}$ gr/dscf

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$C_{s_{12}} = \underline{\qquad}$ gr/dscf

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT Rinellas RESCO

SOURCE Boiler No 1

DATE 5-1-85

RUN NO. 3

CALIBRATION

C_p 0.84

Y 0.989

D_n .267 in.

A_n 3.8882×10^{-4} ft²

NEW DATA

P_b 29.98 in. Hg

P_s 29.97 in. Hg

A_s 79.333 ft²

θ 70 min

V_m 40.930 DCF

ΔH 1.10 in. H₂O

T_m 554 °R

T_s 960 °R

V_{lc} 128.2 ml

$(\sqrt{\Delta P})_{avg.}$ .6448

M_n 0.0270 g.

$$V_{m(std)} = \frac{17.64\ V_m Y\ (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(40.930)(.989)(29.98 + \frac{1.10}{13.6})}{(554)} = 38.7462 \text{ DSCF}$$

$$V_w = 0.0471\ V_{lc} = 0.0471(128.2) = 6.0382 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(6.0382)}{(6.0382)+(38.7462)} = 0.1348$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.9) + 0.32(9.8) + 0.28(80.3) = 29.976$$

$$M_s = M_d(1-B_{ws}) + 18\ B_{ws} = (29.976)(.8652) + 18(.1348) = 28.3616$$

$$V_s = 85.49\ C_p\ (\sqrt{\Delta P})_{avg.}\ (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.6448)\left[\frac{(960)}{(29.97)(28.3616)}\right]^{1/2} = 49.2092 \text{ FPS}$$

$$Q_s = 1058\ (1-B_{ws})\ V_s\ A_s\ (P_s/T_s) =$$

$$1058(.8652)(49.2092)(79.333)\frac{(29.97)}{(960)} = 111{,}562 \text{ DSCFM}$$

234,235 ACFM

$$I = \frac{100\ V_{m(std)}\ A_s}{\theta\ Q_s\ A_n} = \frac{100(38.7462)(79.333)}{(70)(111{,}562)(3.8882 \times 10^{-4})} = 101.2\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0270)}{(38.7462)} = 0.0108 \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(9.8) - .5(\ ) \times 100}{.264(80.3) - [(9.8) - .5(\ )]} = 85.97\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$C_{s_{50}}$ = 0.0133 gr/dscf

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$C_{s_{12}}$ = ______ gr/dscf

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT Pinellas RESCO

SOURCE Boiler No. 2

DATE 5-2-85

RUN NO. 1

CALIBRATION

C_p 0.84

Y 0.989

D_n .267 in.

A_n 3.6882×10^{-4} ft²

NEW DATA

P_b	30.00	in. Hg
P_s	30.00	in. Hg
A_s	79.333	ft²
θ	70	min.
V_m	46.244	DCF
ΔH	1.34	in. H₂O
T_m	549	°R
T_s	992	°R
V_{lc}	135.6	ml
$(\sqrt{\Delta P})_{avg.}$	.7513	
M_n	0.0594	g.

$$V_{m(std)} = \frac{17.64\, V_m Y\, (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(46.244)(.989)(30.00 + \frac{1.34}{13.6})}{(549)} = \underline{44.2306} \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471(135.6) = \underline{6.3868} \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(6.3868)}{(6.3868) + (44.2306)} = \underline{0.1262}$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(8.9) + 0.32(10.6) + 0.28(80.5) = \underline{29.848}$$

$$M_s = M_d(1 - B_{ws}) + 18 B_{ws} = (29.848)(.8738) + 18(.1262) = \underline{28.3528}$$

$$V_s = 85.49\, C_p (\sqrt{\Delta P})_{avg.} (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.7513)\left[\frac{(992)}{(30.00)(28.3528)}\right]^{1/2} = \underline{58.2647} \text{ FPS}$$

$$Q_s = 1058(1 - B_{ws}) V_s A_s (P_s / T_s) =$$

$$1058(.8738)(58.2647)(79.333)\frac{(30.00)}{(992)} = \underline{129{,}231} \text{ DSCFM}$$

277,339 ACFM

$$I = \frac{100\, V_{m(std)} A_s}{\theta\, Q_s A_n} = \frac{100(44.2306)(79.333)}{(70)(129{,}231)(3.6882 \times 10^{-4})} = \underline{99.8}\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0594)}{(44.2306)} = \underline{0.0207} \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(10.6) - .5(0) \times 100}{.264(80.5) - [(10.6) - .5(0)]} = \underline{99.51}\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$C_{s_{50}}$ = 0.0276 gr/dscf

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$C_{s_{12}}$ = ______ gr/dscf

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT Pinellas RESCO

SOURCE Boiler No. 2

DATE 5-2-85

RUN NO. 2

CALIBRATION

C_p 0.84

Y 0.989

D_n .267 in.

A_n 3.8882×10⁻⁴ ft²

NEW DATA

P_b 30.00 in. Hg

P_s 30.00 in. Hg

A_s 79.333 ft²

θ 70 min.

V_m 46.655 DCF

ΔH 1.33 in. H₂O

T_m 555 °R

T_s 998 °R

V_{lc} 151.5 ml

$(\sqrt{\Delta P})_{avg.}$ .7347

M_n 0.0474 g.

$$V_{m(std)} = \frac{17.64\, V_m Y\,(P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(46.655)(.989)(30.00 + \frac{1.33}{13.6})}{(555)} = 44.1402 \text{ DSCF}$$

$$V_w = 0.0471\, V_{lc} = 0.0471(151.5) = 7.1357 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(7.1357)}{(7.1357)+(44.1402)} = 0.1392$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.2) + 0.32(10.4) + 0.28(80.4) = 29.888$$

$$M_s = M_d(1-B_{ws}) + 18\,B_{ws} = (29.888)(.8608) + 18(.1392) = 28.2332$$

$$V_s = 85.49\, C_p\,(\sqrt{\Delta P})_{avg.}\left(T_s / P_s M_s\right)^{1/2} =$$

$$85.49(.84)(.7347)\left[\frac{(998)}{(30.00)(28.2332)}\right]^{1/2} = 57.2703 \text{ FPS}$$

$$Q_s = 1058\,(1-B_{ws})\,V_s\,A_s\,(P_s/T_s) =$$

$$1058(.8608)(57.2703)(79.333)\frac{(30.00)}{(998)} = 124{,}383 \text{ DSCFM}$$

272,605 ACFM

$$I = \frac{100\, V_{m(std)}\, A_s}{\theta\, Q_s\, A_n} = \frac{100(44.1402)(79.333)}{(70)(124{,}383)(3.8882\times10^{-4})} = 103.4\ \%$$

$$C_s = 15.43\,\frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0474)}{(44.1402)} = 0.0166 \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(10.4) - .5(0) \times 100}{.264(80.4) - [(10.4) - .5(0)]} = 96.07\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$C_{s_{50}}$ = 0.0217 gr/dscf

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$C_{s_{12}}$ = ______ gr/dscf

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

PLANT PINELLAS RESCO

SOURCE BOILER NO. 2

DATE 5-2-85

RUN NO. 3

CALIBRATION

C_p	0.84
Y	0.989
D_n	.267 in.
A_n	3.8882×10^{-4} ft²

NEW DATA

P_b	29.95 in. Hg
P_s	29.95 in. Hg
A_s	79.333 ft²
θ	70 min.
V_m	47.749 DCF
ΔH	1.38 in. H₂O
T_m	563 °R
T_s	1002 °R
V_{lc}	182.3 ml
$(\sqrt{\Delta P})_{avg.}$	.7482
M_n	0.0814 g.

$$V_{m(std)} = \frac{17.64\ V_m Y\ (P_b + \Delta H/13.6)}{T_m} =$$

$$\frac{17.64(47.749)(.989)(29.95 + \frac{1.38}{13.6})}{(563)} = 44.4648 \text{ DSCF}$$

$$V_w = 0.0471\ V_{lc} = 0.0471(182.3) = 8.5863 \text{ SCF}$$

$$B_{ws} = \frac{V_w}{V_w + V_{m(std)}} = \frac{(8.5863)}{(8.5863)+(44.4648)} = 0.1619$$

$$M_d = 0.44(\%CO_2) + 0.32(\%O_2) + 0.28(\%CO + \%N_2) =$$

$$0.44(9.4) + 0.32(10.4) + 0.28(80.2) = 29.920$$

$$M_s = M_d(1-B_{ws}) + 18 B_{ws} = (29.920)(.8381) + 18(.1619) = 27.9902$$

$$V_s = 85.49\ C_p\ (\sqrt{\Delta P})_{avg.} (T_s / P_s M_s)^{1/2} =$$

$$85.49(.84)(.7482)\left[\frac{(1002)}{(29.95)(27.9902)}\right]^{1/2} = 58.7415 \text{ FPS}$$

$$Q_s = 1058(1-B_{ws})\ V_s\ A_s\ (P_s/T_s) =$$

$$1058(.8381)(58.7415)(79.333)\frac{(29.95)}{(1002)} = 123{,}512 \text{ DSCFM}$$

279,608 ACFM

$$I = \frac{100\ V_{m(std)}\ A_s}{\theta\ Q_s\ A_n} = \frac{100(44.4648)(79.333)}{(70)(123{,}512)(3.8882 \times 10^{-4})} = 104.9\ \%$$

$$C_s = 15.43 \frac{M_n}{V_{m(std)}} = \frac{(15.43)(.0814)}{(44.4648)} = 0.0282 \text{ gr/SCF}$$

$$\%EA = \frac{\%O_2 - .5\%CO \times 100}{.264\%N_2 - (\%O_2 - .5\%CO)} = \frac{(10.4) - .5(0) \times 100}{.264(80.2) - [(10.4) - .5(0)]} = 96.54\ \%$$

$$C_{s_{50}} = C_s\left(\frac{100 + \%EA}{150}\right)$$

$C_{s_{50}} = 0.0370$ gr/dscf

$$C_{s_{12}} = C_s\left(\frac{12}{\%CO_2}\right)$$

$C_{s_{12}} =$ _______ gr/dscf

SOURCE SAMPLING CALCULATION SHEET

ENVIRONMENTAL ENGINEERING CONSULTANTS, INC.

CONSULTING ENGINEERS, ENVIRONMENTAL SCIENTISTS

State of Florida
DEPARTMENT OF ENVIRONMENTAL REGULATION

INTEROFFICE MEMORANDUM

For Routing To District Offices And/Or To Other Than The Addressee	
To: E. G. Swiples	Loctn.: Tampa
To:	Loctn.:
To:	Loctn.:
From:	Date:
Reply Optional [ ] Reply Required [ ]	Info. Only [ ]
Date Due:	Date Due:

TO: District Managers
District Solid Waste Personnel

THRU: Bill Buzick

FROM: Robert W. McVety
Marshall Mott-Smith

DATE: March 22, 1983

SUBJECT: Solid Waste Workshop

We were pleased with the evaluations submitted by the attendees at our solid waste workshop held in Leesburg on March 2 and 3. We agree that there is a need for more frequent sessions such as these, with encouragement made to upper levels of management to attend. The workshops do provide a forum to learn what other districts are doing and to help assure consistency statewide in the solid waste program. Comments included inviting representatives of local environmental programs in the future. We will do this. It was also suggested that we try to bring in some outside consultants to discuss their viewpoints. We will try to do this also.

Most of us left the workshop seeing the need for additional emphasis on resource recovery, how to best handle waste oil, and how to interpret the new groundwater rule. We received a favorable response to the technical presentations on landfill design and the need to carefully review landfill permits and their renewal. As the revisions to Chapter 17-7 are being drafted, we will be asking you to provide comments and ideas. This is extremely important to us in Tallahassee as well as to the district staff since implementation is done in the field.

As a result of some of the discussions concerning on-site disposal of solid waste and the workload that might be created by requiring permits for this activity, we are revising the legislation being proposed. You have been sent a copy of the suggested language.

Several procedural decisions were agreed upon at the workshop. To insure consistency in the program, the following was agreed to:

1. Site Boundaries:

   Rule 17-3.021(26), Florida Administrative Code, describes a site as:

   (26) "Site" shall mean the area within an installation's property boundary where effluents are released or applied to the groundwater.

The word "Site" is not defined in Rule 17-7, F.A.C., although the word is used in 17-7.05(4) concerning location of monitoring wells at site boundaries, and in 17-7.05(3)(c) regarding design criteria for meeting Rules 17-3 and 4, F.A.C.

The hazardous waste rules, Part 264, Subpart F, §264.95 (Point of Compliance) which we have adopted by reference states that:

(a) The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated limits.

(b) The waste management area is the limit projected in the horizontal plane of the area on which waste will be placed during the active life of a regulated unit.

(1) The waste management area includes horizontal space taken up by any liner, dike, or other barrier designed to contain waste in a regulated unit.

(2) If the facility contains more than one regulated unit, the waste management area is described by an imaginary line circumscribing the several regulated units.

This hazardous waste rule is a good way of interpreting the word "site" in relation to groundwater monitoring of solid waste disposal at sanitary landfills.

2. Liners:

Rule 17-7.03(c) states that the department, following a review of the resource recovery and management facility application and plan, shall:

1. Issue a construction or operation permit if the plan provides reasonable assurances that the requirements and standards of Chapter 17-7, F.A.C., and Chapter 403, F.S., will be met.

2. Issue a construction operation permit which includes conditions and provisions to ensure compliance with Chapter 17-7, F.A.C., and Chapter 403, F.S.

3. Deny the issuance of a construction or operation permit if the plan does not provide reasonable assurances that the requirements of Chapter 17-7, F.A.C., and Chapter 403, F.S., will be met.

The key words are "Reasonable Assurance." Henceforth, unless a liner system is incorporated in a permit application for a landfill site, there are not any reasonable assurances that the plan will meet the requirements of Chapter 403, F.S., and Rule 17-7, F.A.C.

There are many types of liner systems: top, bottom, synthetic, natural clays, etc. The most practically cautious type of liner should be considered in permitting judgments.

Another question that arose at the meeting is still unresolved. Rule 17-4.245(8)(a), F.A.C., concerns secondary drinking water standards compliance in Class G-II groundwater by July 1, 1985. The effects of this rule on permitting is being investigated and you shall be informed of the potential impacts.

RWM/MM-S/s

cc: Mary Smallwood
Rodney DeHan
Greg Parker

Pinellas County
Resource Recovery Project

Supplemental Power Plant Site Certification

PINELLAS COUNTY

RC

SYSTEM

PINELLAS COUNTY FLORIDA

BOARD OF COUNTY COMMISSIONERS

Draft

March 1983

HDR

Henningson, Durham & Richardson

PINELLAS COUNTY

PPSC SUPPLEMENTAL APPLICATION

TABLE OF CONTENTS

PERTINENT APPLICANT

INFORMATION

1. PERTINENT APPLICANT INFORMATION

Company or Applicant's Official Name:	Pinellas County
Address:	315 Haven Street Clearwater, Florida 33516
Address of Official Headquarters:	Same
Business entity:	County Government
Name and Title of Business Head:	Charles Rainey, Chairman of Board of County Commissioners
Name, title and address of official representative responsible for obtaining certification:	Gene Jordan, Director Public Works & Utilities 315 Haven Street Clearwater, Florida 33516
Site Location:	Pinellas County
Nearest Incorporated City:	Pinellas Park
Latitude & Longitude:	27°52' N, 82°40' W
UTMs Northerly:	3084.1
UTMs Easterly:	335.2
Name Plate Generating Capacity Existing:	50.1 MW
Proposed:	No change in electrical capacity but construction of an additional combustion unit.
Remarks:	Pinellas County does not operate, maintain, or construct facilities for the purpose of electric generation. Neither does Pinellas County distribute electrical energy generated at facilities operated by others. The sole purpose of the proposed addition is to dispose of solid waste and recover energy and materials. The proposed addition will afford Pinellas County a more flexible method of solid waste disposal which will substitute for the present landfilling operations.

THE SITE

2.1 Changes in Site Location and Layout

The proposed changes will not involve large changes in land use. Figure 2-1 shows the existing facility and the proposed changes. The site will not be enlarged nor will the electrical generation capacity be increased.

2.2 Changes in Regional Demograph, Land & Water Use

Pinellas County continues to be one of the most densely populated of all Florida Counties. Since the original PPSC application in 1978 the four cities adjacent to the site (St. Petersburg, Largo, Pinellas Park and Kenneth City) have all increased their boundaries by annexation. Those increases that are within a five mile radius of the Facility are indicated in Figure 2-2. The resident populations (1970 and 1980 census) for the above cities and for the rest of the county are listed in Table 2-1. Figure 2-3 shows the present population projections for the area compared to the 1977 projections and the associated change in the solid waste projections.

The present and projected land use within the five mile radius is essentially the same as it was previously. The one notable change is the area within about two miles which is becoming more industrialized and this change is reflected in the latest land use and zoning plans prepared by the county and the various municipalities. Figures 2-4, 2-5 show the changes in the zoning between the original application and the present.

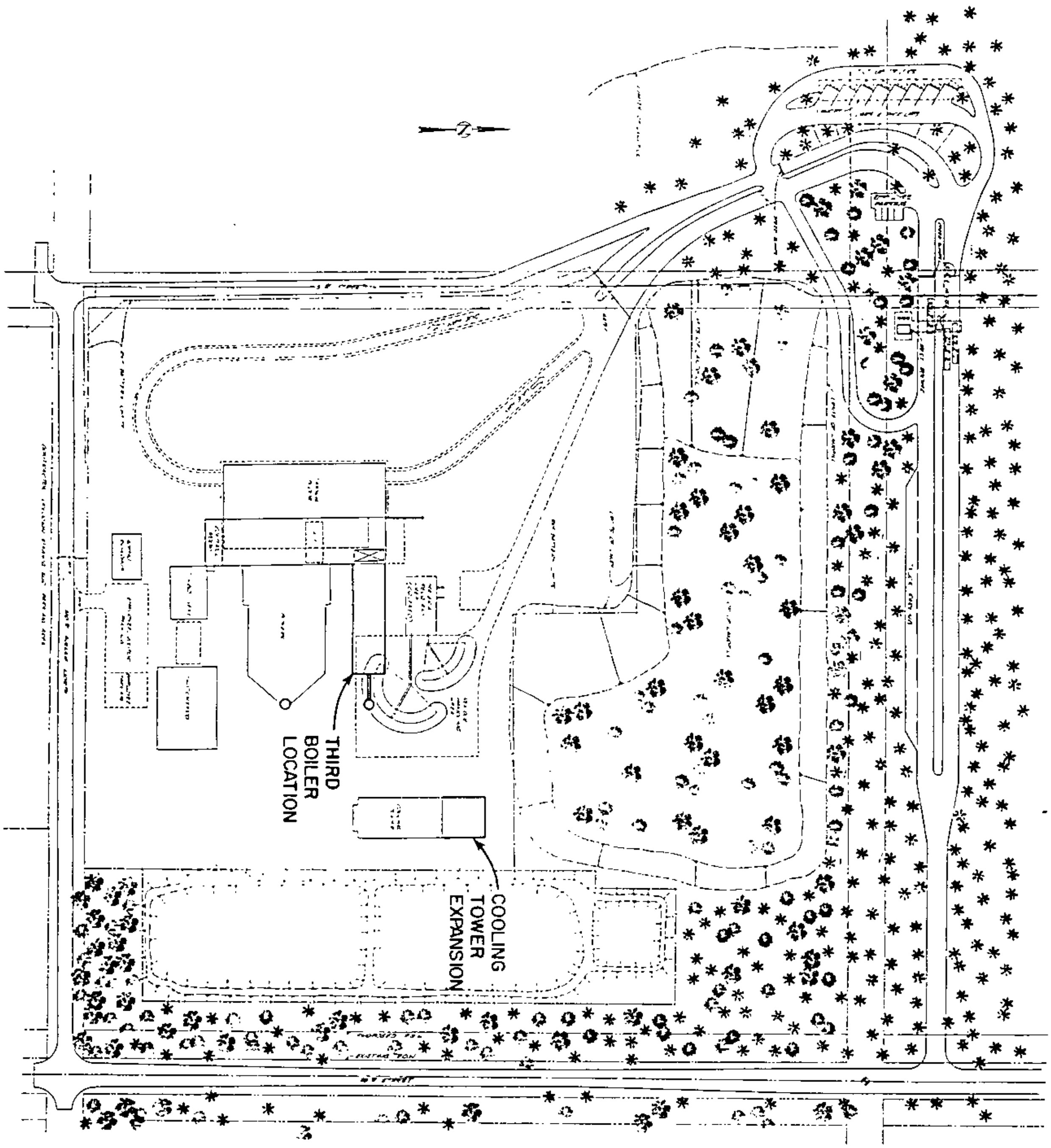
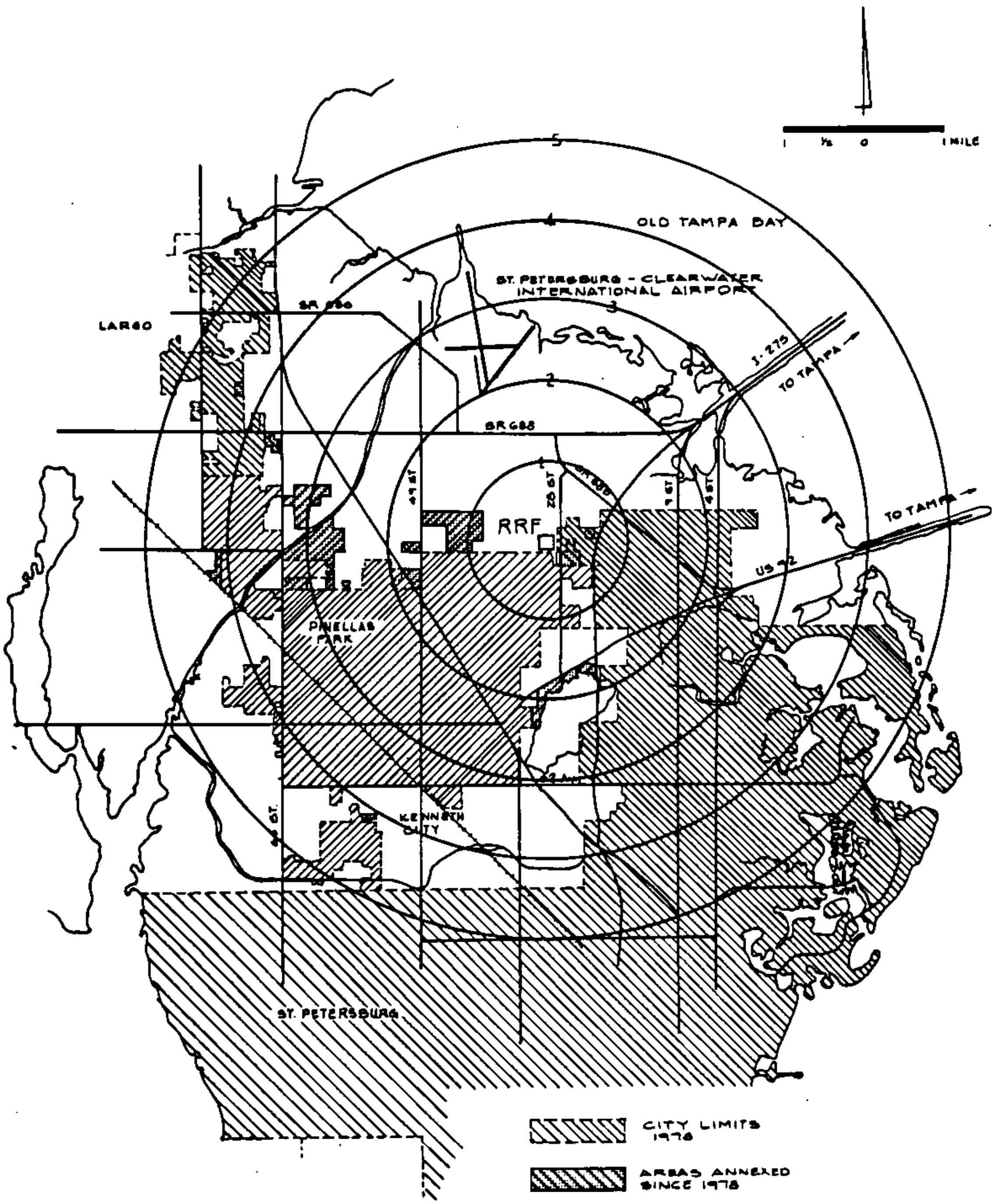


FIGURE 2-1

PINELLAS COUNTY
SOLID WASTE OPERATION PLAN

HENNINGSON, DURHAM & RICHARDSON, INC. ARCHITECTURE ENGINEERING PLANNING SYSTEMS ECOSCIENCES



ANNEXATION CHANGES

FIGURE 2-2

Table 2-1

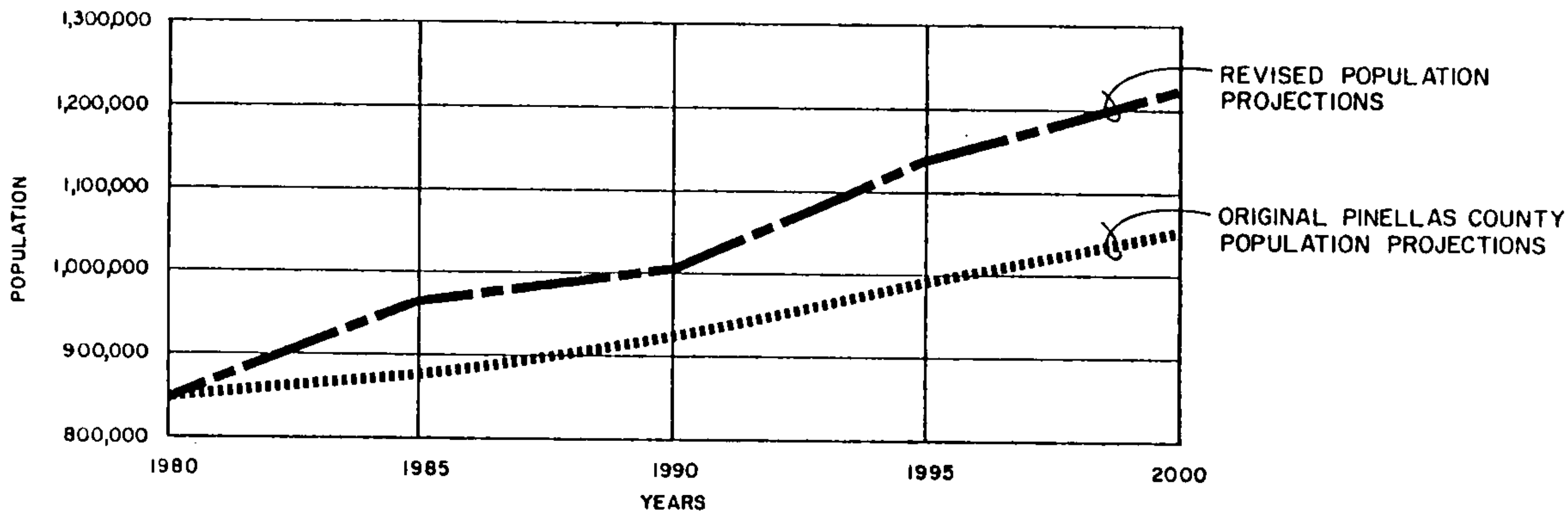
Pinellas County, Florida

1970 and 1980 Census Counts

	Resident Populations		
	1970	1980	Percent Change
Belleair	2,962	3,673	24.0
Belleair Beach	952	1,643	72.6
Belleair Bluffs	1,910	2,522	32.0
Belleair Shores	124	80	(35.5)
Clearwater	52,074	85,528	64.2
Dunedin	17,639	30,203	71.2
Gulfport	9,976	11,180	12.1
Indian Rocks Beach	2,666	3,717	39.4
Indian Shores	791	981	24.4
Kenneth City	3,862	4,344	12.5
Largo	24,230	58,977	143.4
Madeira Beach	4,177	4,520	8.2
North Redington Beach	768	1,156	50.5
Oldsmar	1,538	2,608	69.6
Pinellas Park	22,287	32,811	47.2
Redington Beach	1,583	1,708	7.9
Redington Shores	1,733	2,142	23.6
Safety Harbor	3,103	6,461	108.2
St. Petersburg	216,159	238,647	10.4
St. Petersburg Beach	8,024	9,354	16.6
Seminole	2,121	4,586	116.2
South Pasadena	2,465	4,188	69.9
Tarpon Springs	7,118	13,251	86.2
Treasure Island	6,120	6,316	3.2
Total Incorporated	394,382	530,599	34.5
Total Unincorporated	127,947	197,932	54.7
Total County	522,329	728,531	39.5

Source: U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population and Housing - Florida, Advanced Reports (PHC80-V-11).

PINELLAS COUNTY
SOLID WASTE CURVES



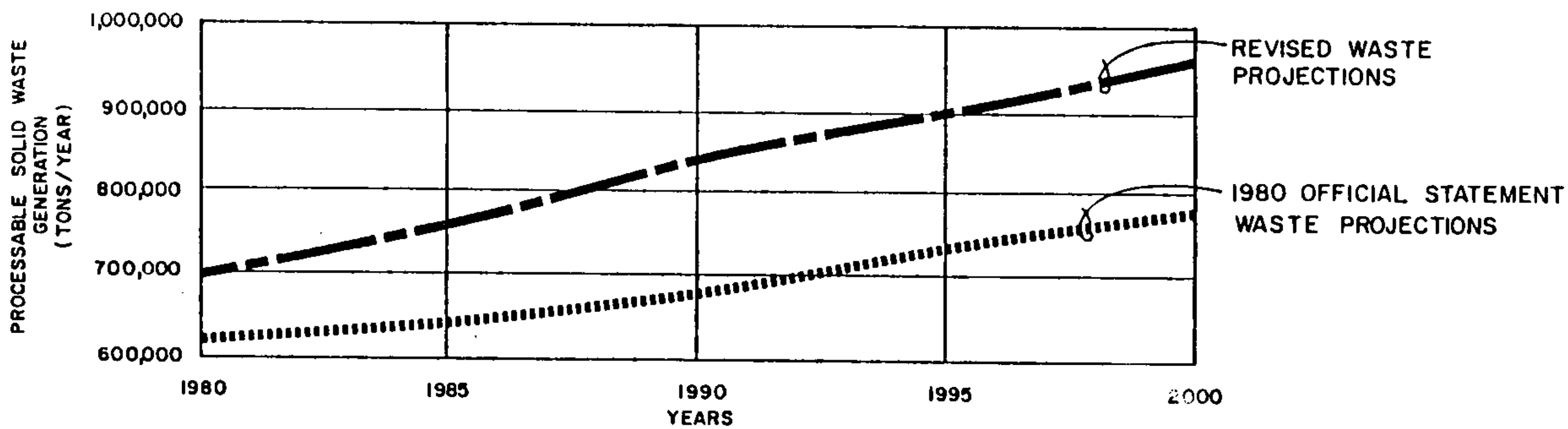
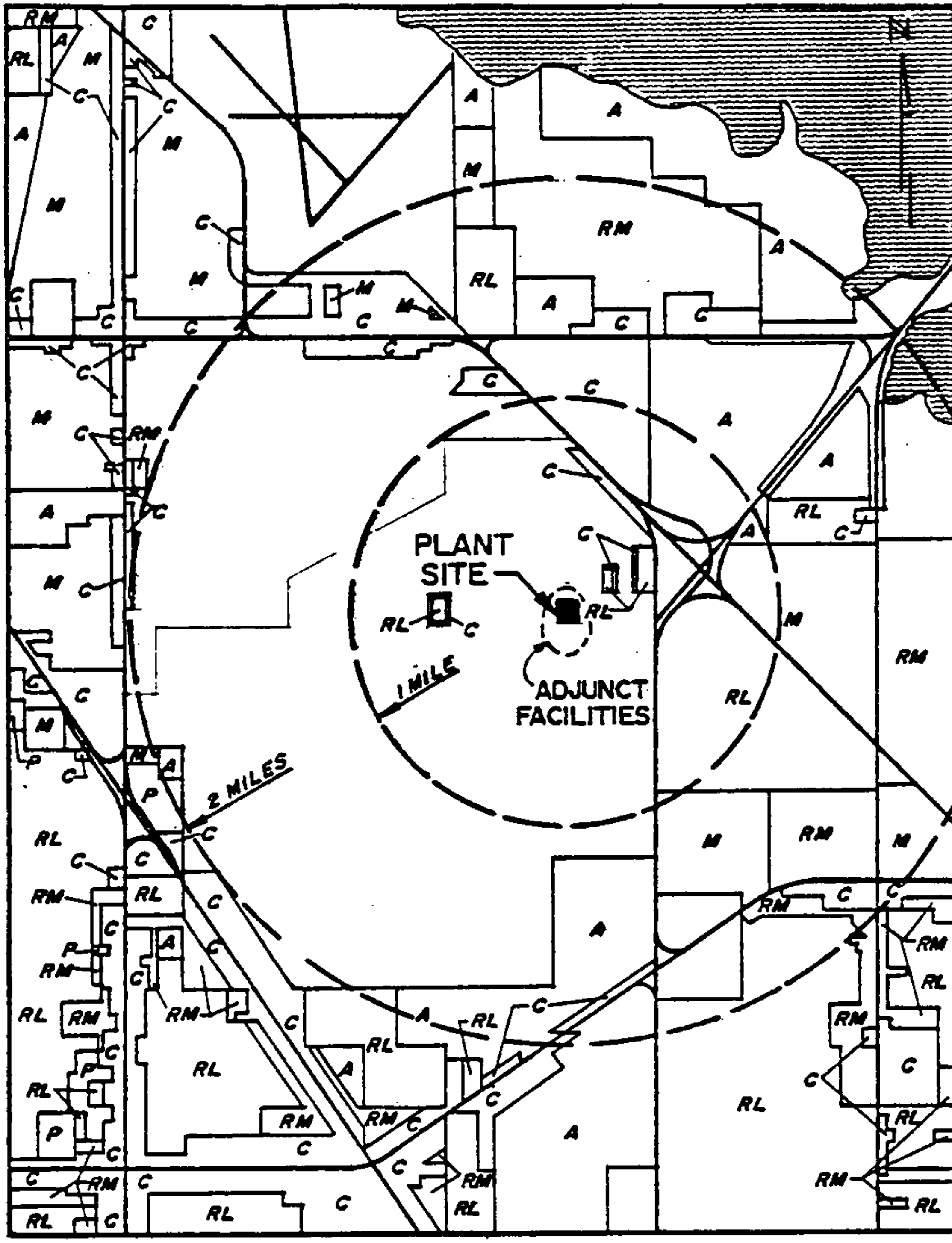


FIGURE 2-3

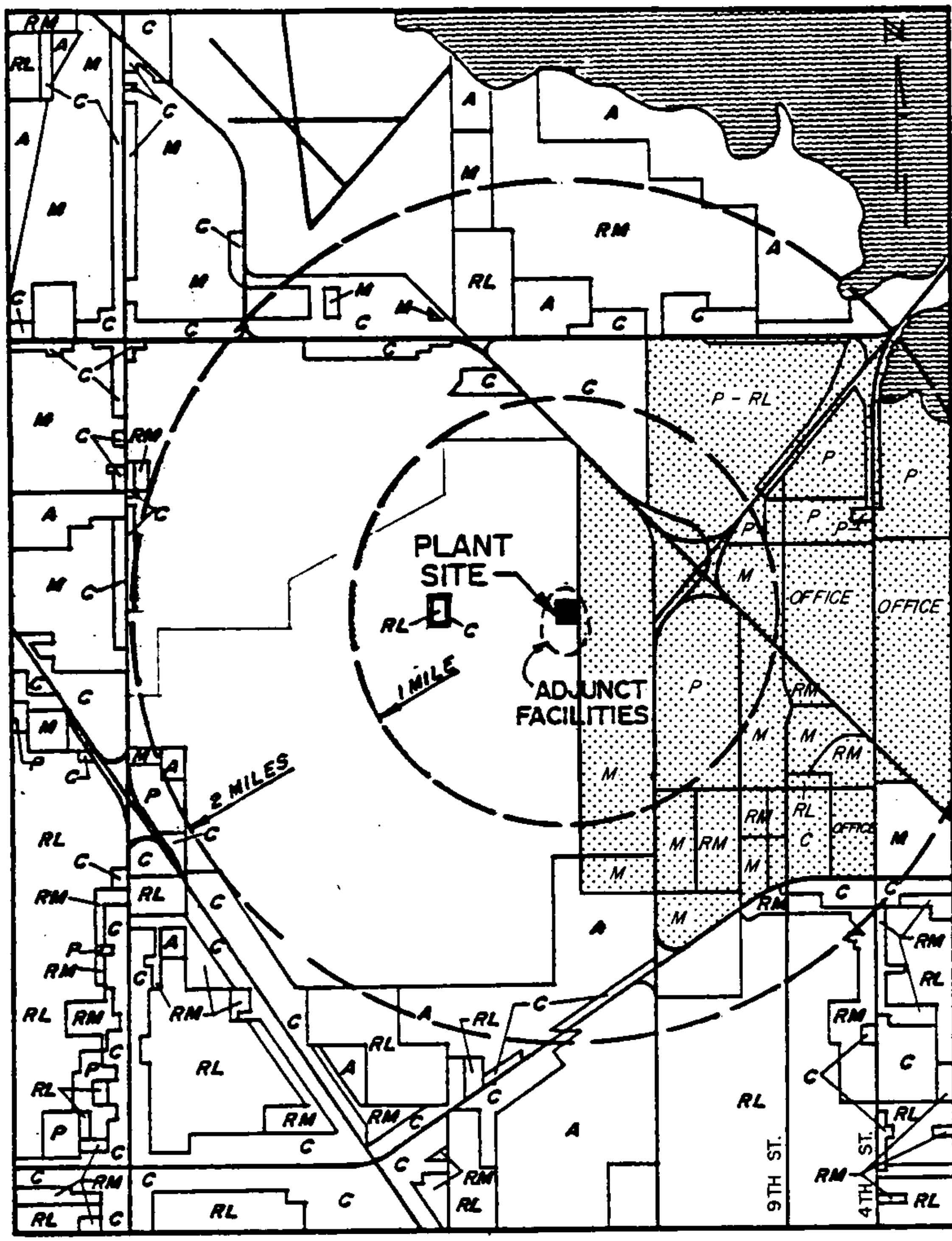


LEGEND

A– AGRICULTURAL C–COMMERCIAL M–MANUFACTURING, INDUSTRIAL
RL– LOW DENSITY RESIDENTIAL RM– MEDIUM DENSITY RESIDENTIAL
P– PUBLIC

ORIGINAL ZONING IN THE STUDY AREA

FIGURE 2-4



LEGEND

A–AGRICULTURAL C–COMMERCIAL M–MANUFACTURING, INDUSTRIAL
RL– LOW DENSITY RESIDENTIAL RM– MEDIUM DENSITY RESIDENTIAL
P– PUBLIC

CHANGES OF ZONING IN STUDY AREA

FIGURE 2–5

The proposed changes at the RRF will require increasing the water supply by 50%. This water will all come from the Largo Wastewater Treatment facility.

2.3 Regional Historic, Scenic, Cultural, & Natural Landmarks

No changes from original application.

2.4 Geology

No changes from original application.

2.5 Hydrology

No changes from original application.

2.6 Meteorology

No changes from original application.

2.7 Ecology

No changes from original application.

2.8 Ambient Air

See Section 3.7.

2.9 Other Environmental Features

No additional factors to be added.

THE PLANT

3.0 The Plant

The purpose of the expansion is two fold: 1) the counties solid waste quantities are greater than previously estimated and extra waste is available from surrounding counties, 2) the original bonds were sold at an opportune time allowing for the formation of additional capital. This additional capital can be used to expand the facility at a low additional cost to the county.

The expansion includes a third combustion unit capable of handling 1050 tpd of solid waste. Two additional cells will be added to the cooling tower system and the steam will be used to insure maximum energy sales. There will be minimal changes to other parts of the facility as needed by the third unit.

3.1 Changes in External Appearance

Figure 3.1 shows a plot plan with the changes as planned for the facility. The visible changes include the second stack and the boiler house. The figure also shows the construction that has taken place since the original application was submitted.

3.2 Fuel

The facility will be capable of handling up to 22,050 tons of solid waste per week, an increase of 7,350 tons. The third unit will allow for a more full load utilization of the existing turbine-generator. The third unit will allow for higher available capacity during times of maintenance or other shutdown of one

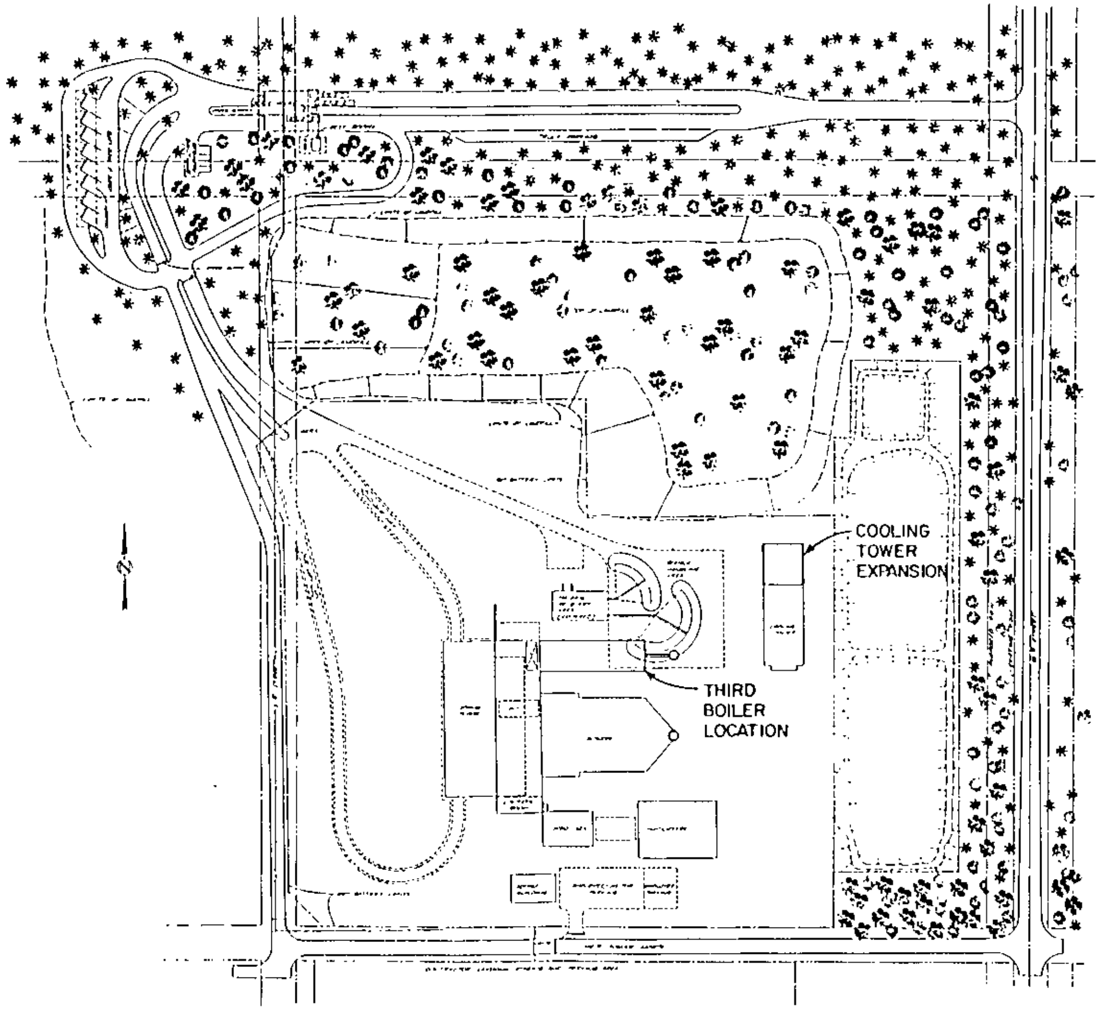


FIGURE 3-1

PINELLAS COUNTY
SOLID WASTE OPERATION PLAN

HENNINGSON, DURHAM & RICHARDSON, INC.

unit. Changes in the original waste projections are shown again on Figure 3-2.

The anticipated analysis of the Boiler Discharge Materials has changed. The changes are shown in Table 3-1.

Table 3-1

Anticipated Analysis of Boiler Discharge Material

	Percent by Weight	
	Previous	Present
Metals	34.5	--
Ferrous	--	25.6
Aluminum	--	2.0
Heavy Non Ferrous	--	1.0
Glass, Ceramic, Stone and Dirt	37.65	37.4
Ash and Unburned Carbon	12.85	19.
Moisture	15.	15.
	100	100

3.3 Plant Water Use Changes

Figure 3-3 presents the revised design water use rates for normal and peak load operation of the facility with the addition of the third unit.

3.4 Heat Dissipation System Changes

This section is complete except that the flow capabilities will increase from 33,400 gpm to 50,100 gpm and the heat rejection load will increase from 450,000,000 Btu/hr to 675,000,000 Btu/hr.

PINELLAS COUNTY
SOLID WASTE CURVES

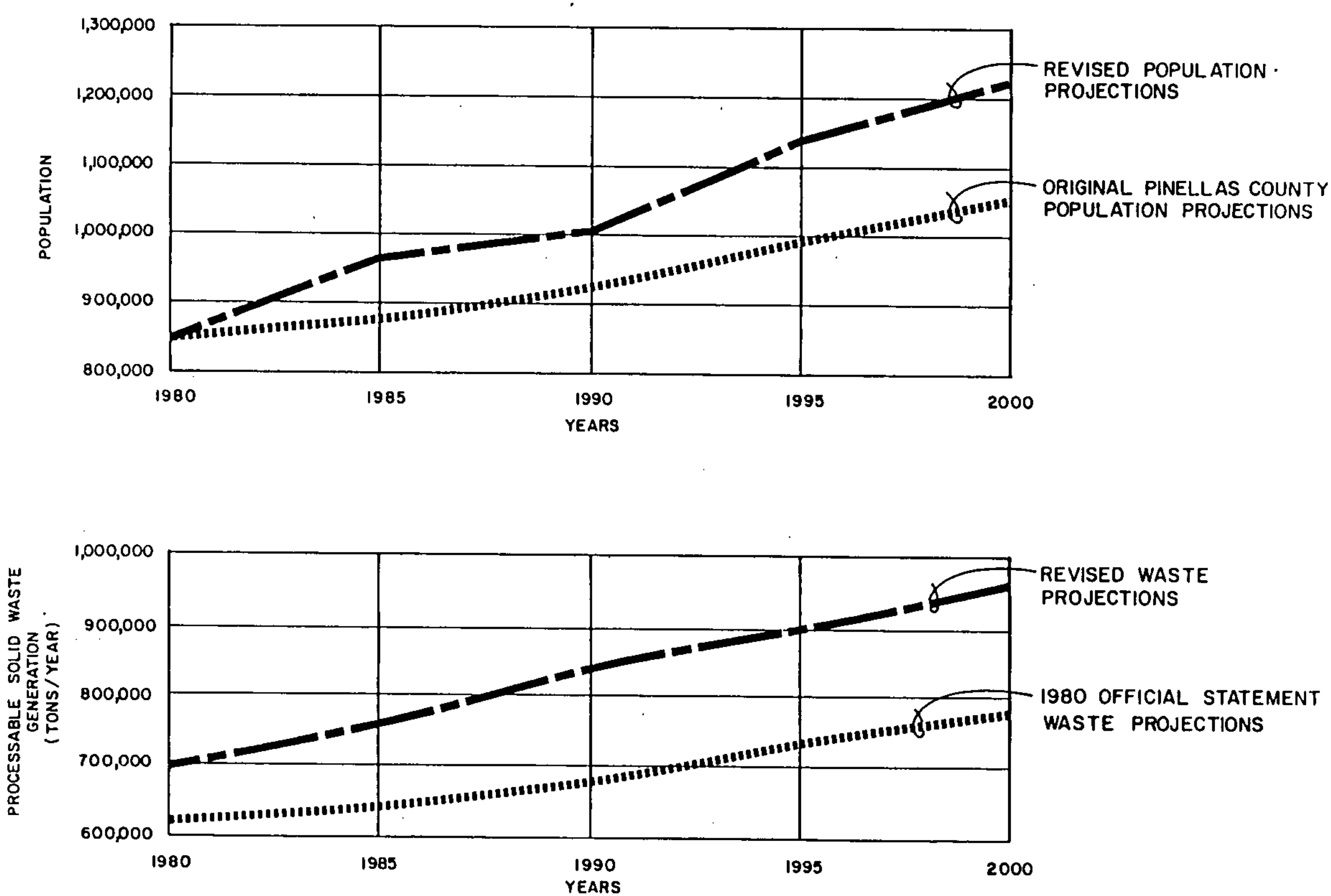


FIGURE 3-2

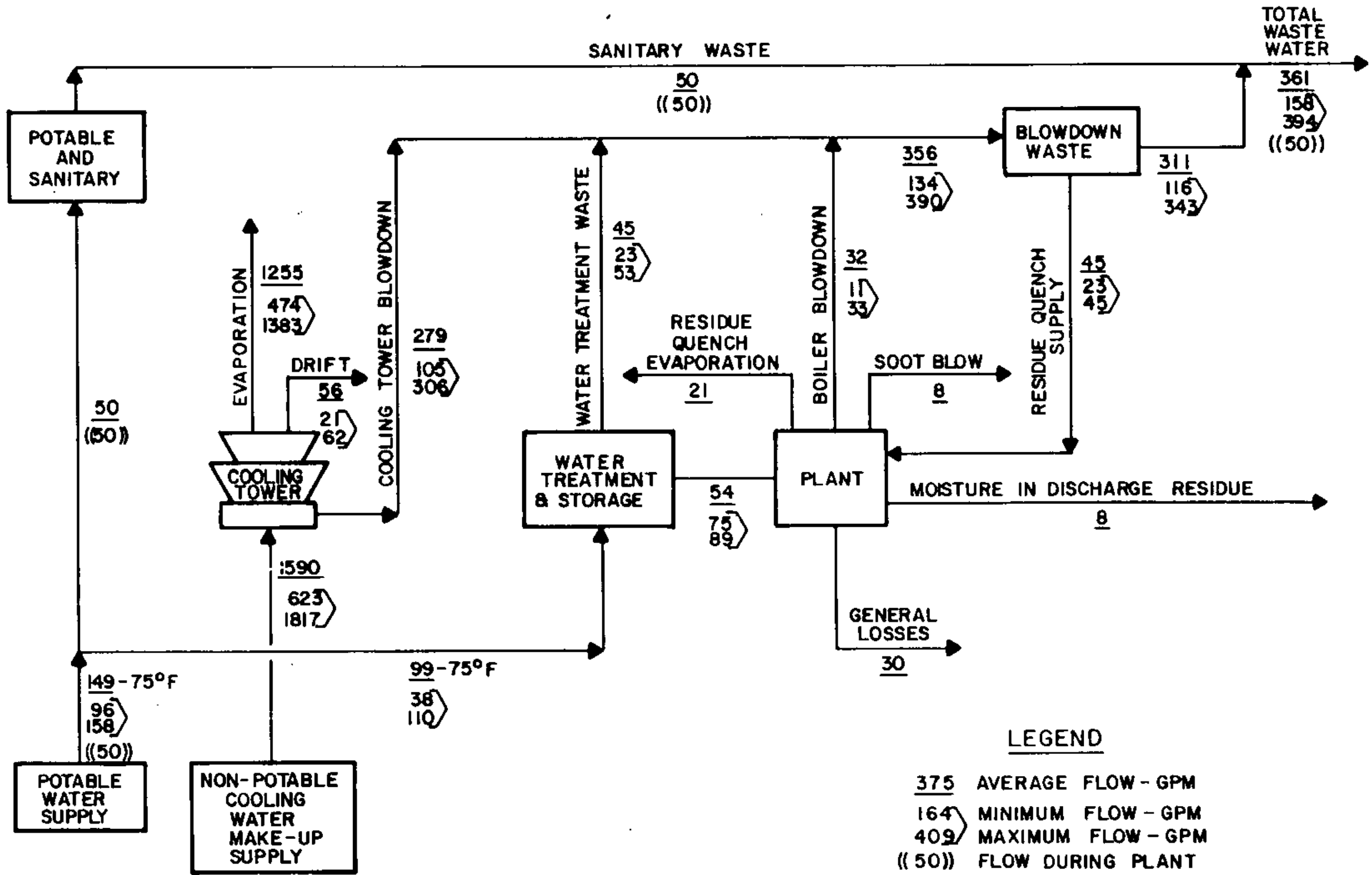


FIGURE 3-3

SUMMARY WATER FLOW DIAGRAM
(BASED ON USING LARGO WATER)

Table 3-2 shows the typical analysis of the cooling tower supply water. Other than the flows involved, very little has changed.

Table 3-2

Chemical Characteristics of Facility
Cooling Water Influent

Chemical Constituent	Potable Supply Pinellas County	Non-Potable Supply 1 (Largo STP)	Non-Potable Supply 2 (St. Petersburg NE STP)
pH	7.7	7.6	6.9
Total hardness as ppm $CaCO_3$	124	248	412
Calcium hardness as ppm $CaCO_3$	108	232	282
Total Alkalinity as ppm $CaCO_3$	90	270	240
P-Alkalinity as ppm $CaCO_3$	0	0	0
OH-Alkalinity as ppm $CaCO_3$	0	0	0
Total dissolved solids, ppm	20	670	1394
Suspended solids, ppm	10	9	30
Conductivity, micromhos/cm	268	938	2390
Calcium, ppm Ca	43	80	97
Magnesium, ppm Mg	4	6	43
Ferric iron, ppm Fe	.05	.11	.298
Bicarbonate, ppm HCO_3	110	324	293
Carbonate, ppm CO_3	0	0	0
Sulfate, ppm SO_4	0	40	100
Chloride, ppm Cl	26	95	522
Silica, ppm SiO_2	16	19	20
Aluminum, ppm Al	.1	.1	.1
Zinc, ppm Zn	.05	.016	.06
Ortho phosphate, ppm PO_4	0	3.3	5

3.4.2 Source of Cooling Water

Cooling tower make-up water will now be obtained from: 1) the City of Largo sewage effluent (treated to land disposal quality), 2) the City of St. Petersburg tertiary treatment plant effluent system and 3) an optional source contemplated in stormwater runoff from the resource recovery site. Quantities available from (1) and (2) are sufficient to supply the requirements individually. The Largo supply will now be the primary source with the St. Petersburg system as the back-up supply. Stormwater runoff will only be utilized for a portion of the make-up due to the insufficient volumes.

3.4.3 System Design

The quantities of water withdrawn from sources of supply were shown in Figure 3-3. The average potable withdrawal is 149 gpm (maximum = 158 gpm and minimum = 96 gpm). The average non-potable withdrawal is 1590 gpm (maximum = 1817 gpm and minimum = 675 gpm).

The consumptive useage rate for the system were shown in Figure 3-3. The consumptive use of water by the facility is in the form of cooling tower losses. Cooling tower losses are in the form of evaporation and drift. The average evaporative loss will be 1255 gpm (minimum = 474 gpm and maximum = 1383 gpm) and the average drift loss will be 56 gpm (minimum = 21 gpm and maximum = 62 gpm).

The location of the cooling towers was shown on the facility layout (Figure 3-1). The cooling tower system will consist of a six (6) cell group of Class 600 Marley cross flow towers or approved substitutes. The average blow down rate for the towers is 279 gpm (minimum = 105 gpm and maximum = 306 gpm). The cooling tower blow down will accumulate along with the boiler dimineralization back flush water (average flow 45 gpm, minimum = 33 gpm, maximum = 53 gpm) and the boiler blow down water (average flow 32 gpm, minimum = 11 gpm, maximum = 23 gpm) for a total process blow down average flow of 356 gpm (minimum = 134 gpm, maximum = 390 gpm). The water that is used to quench the residue discharged from the boiler grates will be drawn from the process blow down cumulative flow. The remaining average process discharge rate will be 311 gpm. Minimum and maximum process flows are 116 gpm and 343 gpm, respectively. Sanitary flow discharge at a rate of 50 gpm will be added to the process flow discharge for an average total discharge of 361 gpm (minimum = 158 gpm, maximum = 394 gpm).

The cooling water increases in temperature by 24°F from 86°F to 110°F in the process of condensing the exhaust steam from the turbine. The water is then cooled by evaporation in the cooling tower. The flow rate through the cooling tower is 56,250 gpm and the evaporation rate from the tower will average 1255 gpm or approximately 2.2% of the circulation rate. No intake structure is anticipated at this time since the cooling water will be drawn from a pressurized main which carries non-potable water and the potable water supply will also be drawn from a pressurized main. The maximum temperature of water at the facility boundary is 92°F. This plant effluent will be pumped to the Pinellas Park lift station; from there it will enter the Pinellas County sewage treatment system. After transporting and mixing with existing flows, very little elevation in temperature will remain.

3.4.4 Blowdown and Trash Disposal

Blowdown will be from the boilers, the cooling towers and the demineralizers as described in Section 3.4.3 above. This cumulative flow, less than 45 gpm, which does not go to the residue quench is discharged after neutralization and stabilization to the municipal sewage treatment plant. The characteristics of this cumulative blowdown flow which will be transported to the sanitary sewer system are shown in Table 3-3.

3.4.5 Injection Wells

No changes from original application.

3.5 Changes in Chemical & Biocide Use

No changes from original application.

3.6 Changes in Sanitary and Other Waste Systems

No changes from original application.

3.7 Air Emissions

With the addition of the third unit, the facility will then consist of three combustion units and two stacks. Units 1 and 2 will be vented through a single stack and Unit 3 will have a separate stack. A full discussion of the air pollution aspects is contained in Appendix A under separate cover.

3.8 New Associated Transmission Lines

No changes from original application.

Table 3-3

Characteristics of Blowdown Mixture (Using Largo Supply)

Parameter	Boiler Blowdown			Cooling Tower Blowdown			Demineralizer			R.O. Reject		
	Q(gpm)	mg/l	#/Day	Q(gpm)	mg/l	#/Day	Q(gpm)	mg/l	#/Day	Q(gpm)	mg/l	#/Day
Ca	32	0	0	279	400	1340	5	36	2	40	236	113
Mg	32	0	0	279	30	101	5	5	1	40	17	8
Na	32	350	135	279	445	1491	5	3398	204	40	248	119
HCO_3	32	100	38	279	475	1592	5	144	9	40	266	128
CO_3	32	0	0	279	0	0	5	0	0	40	0	0
SO_4	32	0	0	279	1445	4842	5	6277	377	40	118	57
Cl	32	100	38	279	475	1592	5	144	9	40	266	128
PO_4	32	40	15	279	17	57	5	5	1	40	9	4
TDS	32	800	308	279	3017	10109	5	10194	612	40	1337	642
TSS	32	100	38	279	75	251	5	0	0	40	50	24
pH	32	10.5	-	279	7.5	-	5	8.5	-	40	6.5	-

3.9 Associated Facilities

All items designated as "to be constructed" for the original project have been constructed.

3.10 On-Site Drainage

The oxidation pond will not use water hyacinths as originally proposed. A report now being prepared by the USGS indicates that significant mineral, metal, and nutrient removal is occurring at this time both in the aeration lagoon and in the ponds originally proposed for use as a hyacinth system. At present these ponds are vegetated by cattails. It is proposed that this sytem be maintained in its current state (with periodic vegetation grubbing) and operated in a manner similar to a stabilization/oxidation lagoon, thus forgoing the use of hyacinths. This report will be forwarded to the DER upon completion. All references in original application to hyacinth pond or system will now refer to as stabilization/oxidation lagoon.

ENVIRONMENTAL EFFECTS OF SITE PREPARATION AND PLANT AND ASSOCIATED FACILITIES CONSTRUCTION

4.0 Environmental Effects of Site Preparation and Plant and Associated Facilities Construction

4.1 Site Preparation and Plant Construction

No changes from original application except those changes concerning air quality. Air quality discussion contained in Appendix A under separate cover.

4.2 Special Features

No changes from original application.

4.3 Resources Committed

No changes from original application.

ENVIRONMENTAL EFFECTS OF PLANT OPERATION

CHAPTER 5

ENVIRONMENTAL EFFECTS OF PLANT OPERATION

The original application states that no related effluent will be discharged to any hydrologic unit. An alternative wastewater disposal system involving land application on mangrove wetlands is being studied. Details of a proposed pilot study will be submitted as soon as they are formulated.

All of the processes remain the same. The flows have changed some and were shown in Section 3.4. The discussion on the water hyacinth is now meaningless as discussed in Section 3.10.

The effect of air emission is completely detailed in Appendix A under separate cover.

All other discussion are as presented in the original application.

5.1 Effects of the Operation of the Heat Dissipation System

No changes from original application.

5.2 Effects of Chemical or Biocide Discharge

No changes from original application.

5.3 Effects of Sanitary and Other Wastes

No changes from original application.

5.4 Effects of Air Emission

Discussed in Appendix A.

5.5 Effects of Operation and Maintenance of the Associated Transmission System

No changes from original application.

5.6 Other Effects

No changes from original application.

5.7 Resources Committed

No changes from original application.

ENVIRONMENTAL MEASURES

AND MONITORING PROGRAM

6.0 Env. Measurements & Monitoring Programs

6.1 General

No changes from original application.

6.2 Pre-application Monitoring

No changes from original application.

6.3 Constructional and Operational Monitoring

No changes from original application. The Conditions of Certification are being complied with.

ECONOMIC AND SOCIAL EFFECTS
OF PLANT CONSTRUCTION AND OPERATIONS

CHAPTER 7

ECONOMIC AND SOCIAL EFFECTS OF PLANT CONSTRUCTION AND OPERATIONS

7.1 Benefits

This section only changes by the amount of waste that can be processed. In the early years, the amounts listed in this section will probably be attained. The original application's values are based on 100% operation at capacity throughput. In actual practice each unit is warranted to be operational 82% of the time. The addition of a third unit will allow the facility, operating full load and 82% availability, to obtain an annual capacity near to two units working full load, 100% availability.

7.2 Costs

The waste disposal situation in Pinellas County has changed since this issuance of the 1980 Series Bonds for the resource recovery facility. The 1980 census uncovered a greater population growth than any previous County projections. This has led to a concern that additional capacity of the resource recovery facility might be needed sooner than anticipated. Ultimately the decision for installing a third unit will be based on the economics of disposing additional waste through resource recovery versus the economics of disposing additional refuse through sanitary landfilling and the availability of land for landfilling.

A schedule was developed for implementing additional capacity from initial investigation through construction and start-up.

UOP-Procon has provided a cost estimate for three alternatives in April 1982 dollars. The capital cost estimates are as follows:

Alternative 1: 1050 TPD boiler unit with full condensing capabilities - $35 million or $33,300/ton.

Alternative 2: 750 TPD boiler unit with full condensing capabilities - $33 million or $44,000/ton.

Alternative 3: 1050 TPD boiler unit with extraction turbine generator complete with switchgear - $44 million or $41,900/ton.

The small capital price differential between the 750 TPD and 1050 TPD facility is offset by additional long-term revenues that can be realized by increased capacity of 1050 TPD over 750 TPD. Therefore, there appears to be no advantage for further investigation of 750 TPD facility.

- Excess money from $160 million dollar bond issue that is projected to be available on 10/1/83 is shown in Table 7-1.

- Comparison of today's debt service costs for adding capacity to the resource recovery facility versus the costs if the capacity had been originally added is shown in Table 7-2.

The 1980 Bond issue was sold at a time when interest rates dipped. Since the issue is used to pay construction costs on a "as

Table 7-1

FORECASTED TRUST INDENTURE

SURPLUS MONIES

Balance in Construction Fund (5/1/83)	20,000,000
Balance in Debt Service Interest Fund (5/1/83)	5,180,000
Interest Fund Bal (5/1/83 to 10/1/83)	2,190,000
SUBTOTAL	$27,370,000
Revenues (5/1/83 - 10/1/83)	
User Fee Revenue	2,670,000
Material Revenue	790,000
Electric Revenue	5,860,000
SUBTOTAL	$9,320,000
Operating Expenses (5/1/83 - 10/1/83)	
County O&M	5,130,000
Renewal, Replacement & Improvement Fund	260,000
SUBTOTAL	(-)$5,390,000
Balance (Revenues - Operating Exp.)	$3,930,000
Interest Debt Service Payment Due	(-)$6,700,000
TOTAL BALANCE (10/1/83)	$24,600,000

Table 7-2

COMPARISON OF OPTION COSTS

	1980 Bond Issue	Cost of the third Unit if purchased now 1983 Bond Issue	
	Two Unit	Three Unit w/o Turbine	Three Unit w/Turbine
UOP Contract Price	59,500,000	34,000,000	43,000,000
Total Cost	109,104,000	*13,000,000	*23,400,000
Bond Issue	160,000,000	18,900,000	34,000,000
Net Debt Service** 4,552,500		16,988,519	2,523,200
Gross Annual Debt Service	16,988,519	19,511,719	21,541,019

* Excess Monies used to Finance Third Unit.

** At 12% interest.

required" basis, substantial sums of money were available for investment.

If these monies are applied to the purchase of the third unit the county can increase its solid waste handling capacity for a relatively small additional cost. The additional money would be acquired via a second bond issue of $18.9 million. Table 7-2compared the existing bond issue between the two bond issues. The result is the acquisition of 50% additional capacity for 15% additional cost.

ALTERNATIVE ENERGY SOURCES AND SITES

CHAPTER 8

ALTERNATIVE ENERGY SOURCES AND SITES

8.1 Assessment of Alternative Sites

No changes from original application.

8.2 Alternative Fuel Analysis

No changes from original application.

8.3 Reasons for Selecting Final Site and Fuel

No changes from original application.

Pinellas County
Resource Recovery Project

Air Quality Analysis

Draft

March 1983

HDR

Henningson, Durham & Richardson

AIR QUALITY SECTION

I. BEST AVAILABLE CONTROL TECHNOLOGY

A. INTRODUCTION

Best Available Control Technology (BACT) is defined in the 40 CFR 52.21 as follows:

> "An emission limitation based on the maximum degree of reduction of each pollutant emitted which the Department, taking into account, energy, environmental and economic impacts and other costs, determines on a case by case basis, is achievable through application of production processes and available methods, systems, and techniques, for control of each such pollutant".

Table I-1 lists the air emissions for which an evaluation for BACT was conducted and control alternatives (both commercially available and in the research stage) which were considered for the control of each of the pollutants. The air pollutants and the emission levels for which BACT must be determined are shown in Table I-2.

TABLE I-1
BACT POLLUTANTS AND CONTROL ALTERNATIVES

Air Emission Parameter	Control Alternatives
Particulate	Electrostatic Precipitator (ESP) Wet or Dry Scrubber Fabric Filter Electrostatic Baghouse
Sulfur Dioxide	Wet Scrubber Dry Scrubber Low Sulfur Fuel
Air Pollutants	Control Alternatives
Nitrogen Oxide	Ammonia Injection Wet Scrubber Catalytic Reduction Design and Operating Procedures
Carbon Monoxide	Design and Operating Procedures
Lead & Beryllium & Particulate Mercury	Electrostatic Precipitator (ESP) Wet or Dry Scrubber Fabric Filter
Hydrogen Fluoride & Gaseous Mercury	Wet & Dry Scrubber

TABLE I-2
BACT POLLUTANTS AND ANNUAL EMISSIONS

Air Emission Parameter	Tons/Year
Particulate	109
Sulfur Dioxide	577
Nitrogen Oxide	577
Carbon Monoxide	288
Lead	58
Beryllium	0.0019
Mercury (particulate & gaseous)	2.1
Hydrogen Fluoride	28

This BACT evaluation of the above described control alternatives considered their technical feasibility, energy usage and certain environmental factors. The proposed unit is projected to be on-line approximately 80-85% of the time. Air pollution control equipment must be reliable to minimize contribution to unit downtime. A projection of the equipment's reliability can be developed only after it has received commercial application; therefore, commercial application of the equipment was reviewed in formulating BACT. Installation of air pollution control equipment increases the facility cost, but results in benefits to the surrounding area and population. At some point, the cost of air pollution control equipment is not outweighed by the resulting benefits. To this end, the capital, operational and energy costs, were compared to the benefits. Air pollution control equipment will lessen the facility's air emissions, however, increasing the waste requiring land disposal resulting from the additional equipment operation is not advantageous.

B. TOTAL SUSPENDED PARTICULATE (TSP), LEAD, BERYLLIUM AND PARTICULATE MERCURY

In this section, BACT for control of total suspended particulate (TSP) emissions is proposed. The control device which is BACT for TSP will also concurrently control lead, beryllium and the particulate form of mercury, and is thus also proposed as BACT for these pollutants.

An electrostatic precipitator with an outlet particulate loading of 0.03 gr/dscf, corrected to 12% CO_2, is proposed as BACT for this project. Other control alternatives reviewed include ESP's with emission rates of 0.05 and 0.015 gr/dscf at 12% CO_2, two different Fabric Filters, and a Dry Acid Gas Scrubber.

1. Electrostatic Precipitators

Electrostatic precipitators function by imparting a negative charge to particulates in the flue gas stream. The particles are then attracted to positively charged plates, where they are collected. Characteristics of electrostatic precipitators include the following:

- Generally capable of particulate removal efficiencies greater than 98% with efficiencies as high as 99.8%.
- Can handle high temperature gases of over 600°F in special applications.
- Low pressure drop through units resulting in lower energy usage by fans.
- Performance is sensitive to actual vs. design flue gas flow rates (actual gas flow must be less than design) and particle resistivity.
- Consideration must be given to prevent corrosion caused by acid gas condensation. Acid mist condensation begins about 250°F.
- Recognized as the most reliable and efficient technology on resource recovery systems.

Table I-3 shows estimated costs for electrostatic precipitators investigated for this project.

2. Fabric Filters/Electrostatic Baghouses

Baghouses remove particulate by filtering the flue gas stream through a fabric. Actually, most of the effectiveness is attributed to filtering through a mat of particulate which has built-up on the surface of the fabric. Characteristics of baghouses are as follows:

- Particulate removal efficiencies as high as 99.8% have been demonstrated on coal fired units.
- Variations in flue gas flow rate and particulate composition do not generally effect performance.
- Pressure drop through units is significant resulting in relatively high energy usage by fans.
- Available filter materials limit operating temperatures to less than 500°F.
- Sparks in flue gas can cause pinhole leaks and even fires within the filter.

TABLE I-3
COSTS OF ELECTROSTATIC PRECIPITATORS
1050 TPD Unit

Emission Limit gr/dscf @ 12% CO_2	0.05	0.03	0.015
Removal Efficiency, Percent	98.0	98.7	99.4
Construction Cost	$1,707,700	$2,003,400	$2,592,300
Annual Cost:			
Net Dedt Service	$ 299,500	$ 351,400	$ 454,700
Operating and Maintenance Costs	$ 179,300	$ 222,400	$ 298,100
Total	$ 478,800	$ 573,800	$ 752,800
Unit Cost:			
Per Ton MSW (300,000)	$ 1.60	$ 1.91	$ 2.51
Per Ton Particulate Removed	$ 45	$ 53	$ 69
Incremental Costs:			
Additional Tons Removed	base	100	45
Additional Annual Cost	base	$ 95,000	$ 179,000
Per Ton Removed		$ 863	$ 3,980
Per Ton MSW (300,000)		$ 0.31	$ .60

- Consideration must be given to prevention of corrosion caused by acid gas condensation.

- Experience on resource recovery facilities is very limited.

Table I-4 shows estimated costs for the baghouse systems investigated for this project. The TSP emission rate would be guaranteed less than 0.01 gr/dscf corrected to 12% CO_2.

3. Dry Scrubbers

Dry scrubbers are devices which are designed to remove SO_2 and acid gases from the flue gas stream, in addition to particulates. Aqueous solutions of lime are sprayed into the gas stream, which react with the SO_2 and acid gases. Heat from the reaction, and from the flue gas, dry the resultant products, which are then collected in a baghouse. Characteristics of dry scrubbers are the same as those for baghouses, except as follows:

- SO_2, acid gases and other flue gas constituents, that may condense with lower exit gas temperatures are controlled.

- Acid gas corrosion may be less of a problem.

- Approximately twice as much residue is produced.

- Experience on resource recovery facilities is even more limited.

Table I-5 shows estimated costs for a dry scrubber and baghouse system, guaranteed for a TSP emission limit of 0.01 gr/dscf, corrected to 12% CO_2, and guaranteed to remove 70% of the SO_2 and 70% of the HCL in the flue gas stream.

C. SULFUR DIOXIDE (SO_2) AND ACID GASES

Use of a low sulfur fuel is currently considered by many as BACT for control of sulfur dioxide emissions Municipal solid waste (MSW) is inherently a low sulfur fuel with a sulfur content of approximately 0.15 $\pm$ 0.1%.

A control alternative which was examined for this report is the use of a dry scrubber system for SO_2 control, which simultaneously controls emissions of acid gases. Use of a dry scrubber has been examined for particulate control in the particulate BACT analysis. Wet scrubbing for SO_2 control was not investigated due to the presence of a vapor plume. Even though the gas has been cleaned the steam plume is considered unacceptable and eliminates this option.

TABLE I-4
COSTS OF FABRIC FILTER SYSTEMS
1050 TPD Unit

	Pulse Jet Fabric Filter	Reverse Air Fabric Filter
Emission Limit, * gr/dscf @ 12% CO_2	0.01	0.01
Removal Efficiency, Percent	99.6+	99.6+
Construction Cost	$1,381,000	$1,620,000
Annual Cost:		
Debt Service	$ 151,200	$ 177,700
Operating and Maintenance Costs	$ 359,000	$ 421,200
Total	$ 510,500	$ 598,900
Unit Cost:		
Per Ton MSW (120,000 tpy)	$ 1.70	$ 2.00
Per Ton Particulate Removed	$ 47	$ 55
Incremental Annual Cost	base	$ 88,400
Incremental Cost Per Ton MSW	base	$ 0.30

* Due to nature of fabric filters the collection efficiency and emission limit cannot be specified. The listed values indicate minimum acceptable performance.

TABLE I-5
DRY SCRUBBER/FABRIC FILTER SYSTEM
1050 TPD Unit

	Dry Scrubber Plus Fabric Filter
Emission Limit, gr/dscf @12% CO_2	0.015
Removal Efficiency, Percent	99 +
Construction Cost	$5,000,000
Annual Cost:	
Debt Service	$ 823,500
Operating and Maintenance Costs	$1,425,000
Total	$2,248,500
Unit Cost:	
Per Ton MSW (300,000 tpy)	$ 7.50
Per Ton Particulate Removed	$ 206

Table I-6 shows general effects of SO_2 control alternatives.

TABLE I-6
EFFECTS OF SO_2 CONTROL ALTERNATIVES

Area of Effect	Low Sulfur Fuel	Dry Scrubber
Energy Consumption	No effect	Increased facility energy consumption
Environmental	Reduced emissions of SO_2 compared to other fossil fuels	Reduced emissions of SO_2, HF and gaseous mercury; increased amounts of residues requiring land disposal
Economic	No direct facility related costs	Increased facility capital and operating costs

1. Low Sulfur Fuel

The emission rate of sulfur dioxide is dependent on the amount of sulfur in the fuel. Municipal solid waste is estimated to have a sulfur content of less than 0.2%. Generally, coal-fired facilities have switched from high (5-7%) to low (1-2%) sulfur coal to comply with laws and regulations. The proposed unit will utilize municipal solid waste which is much lower in sulfur content.

2. Dry Scrubbers

Dry scrubbers operate by injecting droplets of alkali reagent into the flue gas. The resulting reactions remove the sulfur dioxide as sulfites and sulfates in particulate form. The heat generated during the reaction plus flue gas heat evaporates the water carrying the alkali reagent. A particulate removal device is located downstream to remove the sulfate and sulfite particulates. The first commercial scale dry scrubber has just gone on-line at the coal-fired Northern States Power Company's Riverside Power Plant in Minneapolis, Minnesota. The system's costs and effects were based upon projections provided by system vendors.

Table I-7 shows estimated costs of a dry scrubber to control particulates, SO_2 and acid gases.

TABLE I-7
DRY SCRUBBER COSTS

Total Annual Cost (Debt Service + O&M)	$2,248,500 (1)
Annual Cost attributable to particulate control	$ 573,800/year (2)
Annual Cost attributable to SO_2 + acid gas control	$1,674,700/year (3)
Incremental Cost per ton of SO_2 + acid gas controlled	$ 1,600/ton (4)

Notes:
1. From Table I-5
2. Proportioned such that cost for particulate removal is equal to cost for electrostatic precipitator.
3. Total cost less that attributable to partiulate.
4. Based on guaranteed removal efficiencies, i.e. 70% removal of SO_2 and 90% removal of HCL.

D. NITROGEN OXIDE

The technologies for nitrogen oxide (NO_x) control include ammonia injection, wet scrubbers, and catalytic reduction. However, none have been utilized on a commmercial scale at either resource recovery facilities or coal-fired power plants in the United States.

Research relative to ammonia injection has revealed the following utilization limiting factors:

- When the flue gas temperature is between 1600^oF and 1650^oF, the reaction:

  $$NH_3 + NO + O_2 \rightleftharpoons N_2 + 3/2\ H_2O$$

  readily takes place, controlling NO emissions. Above 1800^oF, the NH_3 is oxidized to NO. Below 1600^oF, the reaction does not take place. A supplemental heating source may be required to maintain the appropriate temperature envelope.

- Ammonia can react with sulfur trioxide in the flue gas to form ammonium sulfate or ammonium bisulfate. Ammonium bisulfate can condense after emission to the atmosphere and act as a corrosive agent.

- Cyanide formation at the ammonia injection zone has occurred in the presence of hydrocarbons.

- Ammonium Chloride formation has been documented and forms a pervasive visible plume.

Research on nitrogen oxide control with catalytic reduction processes has identified the following problems:

- Formation of ammonium bisulfate with resulting corrosivity
- Blinding of the catalyst
- Catalyst corrosion
- Formation of unexpected compounds

The wet scrubber has been demonstrated only on a glass manufacturing furnace. The information is insufficient to judge its applicability to a municipal solid waste fired resource recovery facility.

Nitrogen oxides (NO_x) result from the reaction of atmospheric nitrogen and oxygen in the combustion zone and the partial combustion of nitrogenous compounds in the fuel. Important factors affecting NO_x production are flame and furnace temperature, residence time of combustion gases at flame temperature, rate of gas cooling, and amount of excess air.

Given the state of the art of NO_x control technologies, refuse feeding, and the importance of temperature zone parameters in NO_x generation, the BACT recommendation for the proposed resource recovery facilities is the use of proper boiler design and operating procedures.

E. CARBON MONOXIDE

Carbon Monoxide is a product of incomplete combustion. The generalized reaction is shown below:

$$HC + O_2 \rightarrow CO + HC' + H_2O$$

When incomplete combustion takes place energy is lost, carbon monoxide and another hydrocarbon are formed. The new hydrocarbon is a pyrolyisis product and may combust further. BACT is the use of state-of-the-art boiler controls to insure sufficient underfire and overfire air so that the emissions of products of incomplete combustion are minimized.

The underfire air has three purposes: 1) to ignite the refuse, 2) cool the grates, and 3) supply air to all parts of the fuel bed. The overfire air causes turbulence in the fire ball to assist in complete burnout.

There are four steps in the combustion of refuse or any damp fuel:

1) drying
2) volitization
3) pyrolyzing
4) direct combustion

The step that contributes to carbon monoxide production is the pyrolysis step. Pyrolysing is the breaking down of larger organic compound in to smaller organic compounds by the application of heat. This differs little from cracking of crude oils into various fractions.

In a mass burn system, this cracking takes place in the presence of some air but still in a reducing atmosphere. Incomplete combustion can take place producing carbon monoxide. In a properly designed system, the products of pyrolysis are consumed in the fire ball section of the incinerator.

The fireball's intensity is controlled by high velocity overfire air. As long as sufficient overfire air is supplied to insure approximately 100% excess air, carbon monoxide production will be minimized.

There are no controls for carbon monoxide production other than state-of-the-art boiler design and control is BACT for CO control. The boiler will be designed to operate at peak efficiency which will minimize products of incomplete combustion.

II. AIR QUALITY ANALYSIS

A. INTRODUCTION

Available data indicate that emission levels as listed in Table II-1 are attainable by mass burn resource recovery facilities. These emission levels at a throughput of 1050 TPD will be used in the modeling required for the PSD permit.

TABLE II-1
EXPECTED EMISSIONS

Pollutant	lb of Pollutant Ton of MSW	lb of Pollutant Per Hour
Particulate	0.6	26.3
Sulfur Dioxide	3.0	131.3
Nitrogen Dioxide	3.0	131.3
Carbon Monoxide	1.5	65.6
Hydrocarbons	0.3	13.1
Lead	0.1	4.4
Mercury	0.01	0.44
Beryllium	$1.0x10^{-5}$	$4.4x10^{-4}$
Fluorides	0.1	4.4
Chlorides	4.0	175

Table II-1 is expanded in Table II-2 to indicate the equivalent emission factors used in the various parts of the Air Quality Analysis. The Resource Recovery Facility (RRF) is a PSD significant source for all criteria and several non-criteria pollutants. Table II-3 lists the stack parameters used in the analysis of this unit.

TABLE II-2
3RD UNIT
RRF EMISSIONS & STACK PARAMETERS

Pollutant	Equivalent Factors Lb. Ton MSW	lb/hr	TPY	gm/s
Particulate	0.6	25	115	3.15
Sulfur Dioxide	3.0	132	577	16.6
Nitrogen Dioxide	3.0	132	577	16.6
Carbon Monoxide	1.5	66	288	8.3
Hydrocarbons	0.3	13.1	58	1.68
Lead	0.07	4.4	19	.56
Mercury	0.01	19.5	2.1	.06
Beryllium	$7.7x10^{-5}$	$3.1x10^{-4}$	$1.3x10^{-3}$	$3.9x10^{-5}$
Fluorides	0.1	4.4	38	.55
Chlorides	4.0	174	764	22

TABLE II-3
STACK PARAMETERS

Parameters	Unit 3 Metric	English
Volumetric Flow	118. m^3/s	251,000 acfm
Stack Diameter	2.4 m	7.8 ft.
Stack Height	49.1 m	161 ft.
Exit Velocity	26.8 m/s	88 ft./s
Exit Temperature	505 ^oK	450 ^oF

The Good Engineering Practice stack height for this facility is 290 ft. The planned stack height is 161 ft. to be consistent with the existing construction. The shortness is due to the Clearwater - St. Petersburg Airport being 11,000 ft. from the facility. Negotiations with the Federal

Aviation Authority indicate that a stack height higher than 178 ft. will interfere with the approach surface to the airport.

A stack this short could significantly affect the air quality impacts caused by the facility. These impacts were investigated and are explained in Section II-E.

B. MODELING

To model the air quality impact due to the planned facility expansion, the following protocol will be used:

1. Unit Three will be identical to Units One and Two, actual design data for those units has been used for Unit Three. This data was developed in the design process and varies from that in the original application.

2. The CRSTER modeling will include all three units. Units 1 and 2 are calculated and will emit from a single stack. The emissions from Unit 3 will come from a separate stack.

   The hot spots from this analysis will be remodeled with only Unit 3 to determine the impact caused by that unit.

3. The other sources that will be modeled include the Florida Power Plants at Anclote, Higgins, and Bartow, the Stauffer facility in Tarpon Springs and the Golden Triangle Asphalt Plant. Emissions from TECO's Hooker Point, Big Ben, and Gannon Plants will be investigated to determine what effect they will have.

4. The CRSTER Model will be used from UNAMAP 4 for the primary modeling of the facility. Meteorological data from Tampa International years 1970-74 will be used. The meteorological data developed for the McKay Bay application as corrected will be used.

5. The other facilities will be modeled using PTDIS and/or PTMTP to investigate the additive impacts of these facilities.

6. This data will be added to the County's monitored background. The source of this data will be the monitoring station that is closest to the area of the highest expected impacts.

The short stack being used here could cause a downwash problem. To investigate this possibility the procedure outlined by Huber and Snyder (1976) was used in conjunction with the discussion presented in the Industrial Source Complex (ISC) model. Discussion of this analysis is included in Section II-E.

C. IMPACT ANALYSIS

The modeling analysis was based on the sulfur dioxide emissions. A basic assumption used here is that no deposition or pollutant half-life exists. To determine the impact of the other pollutants, that pollutant's emission rate will be ratioed by the sulfur dioxide emission rate. This ratio will then be multiplied by the corresponding sulfur dioxide impact to determine the impact of each individual pollutant.

The project's modeled impacts are shown in Table II-4 without background. All of the modeled impacts are small enough as to not affect any FAAQS or NAAQS.

To investigate any possible plume interactions the batch version of EPA's PTMTP model was run. Interactions were investigated with the following sources:

1) Florida Power Corporation (FPC) Bartow Powerplant
2) Florida Power Corporation (FPC) Higgings Powerplant
3) Florida Power Corporation (FPC) Anclote Powerplant
4) Tampa Electric Company (TECO) Big Bend Powerplant
5) Tampa Electric Company (TECO) Gannon Powerplant
6) Tampa Electric Company (TECO) High Bridge Powerplant
7) McKay Bay Resource Recovery Facility

Shown in Table II-5 are the sulfur dioxide impacts determined by this model. The receptors represent: 1) the plant site, 2) the highest 3-hr impact and, 3) the highest 24-hr impact respectively. Also shown are the wind directions investigated and the source(s) causing the major impact.

Table II-6 indicates the impacts modeled for particulate. The values in Table II-5 and 6 represent each facility operating at their permit conditions. It can be determined from these data that even under the conservative assumptions used in the PTMTP model these interactions will not endanger the FAAQS.

D. MONITORING

The PSD regulations require air monitoring to determine the existing air quality. Sources may be exempted from monitoring if the modeled impacts are below certain de minimis values. The de minimis values and the modeled impacts are shown in Table II-7.

TABLE II-4
PROJECT'S HIGHEST MODELED IMPACTS
All 3 Units
Without Downwash Effect

Pollutant	Concentration (ug/m^3)	Year	Location (Direction, Ring)
Particulate			
24 Hr.	1.44	1970	25, 4.7km
Annual	0.16	1971	9, 2.7km
Sulfur Dioxide			
3 Hr.	28	1970	9, 2.1km
24 Hr.	7.2	1970	25, 4.7km
Annual	0.8	1971	9, 2.7km
Nitrogen Dioxide			
Annual	0.8	1971	9, 2.7km
Lead			
24 hr.	0.24	1970	25, 4.7km
Mercury			
24 hr.	0.024	1970	25, 4.7km
Beryllium			
24 hr.	2.4×10^{-5}	1970	25, 4.7km
Fluoride			
24 hr.	0.24	1970	25, 4.7km

TABLE II-5

PTMTP RESULTS
Sulfur Dioxide
(ug/m^3)

Wind Direction	Receptor 1	2	3	Major Source
340	104	150	2	Anclote
360	35	52	14	Higgings & Anclote
70	3.1	5.1	140	Gannon, Highbridge, McKay Bay
80	136	157	120	Gannon, Highbridge
90	40	24	40	Bartow, Gannon, Highbridge
100	201	129	277	Bartow, Big Bend
110	400	508	5.4	Big Bend
120	10	29		Big Bend

TABLE II-6

PTMTP RESULTS
Particulate
(ug/m^3)

Wind Direction	Receptor 1	2	3	Major Source
340	3.7	5.3	0.1	Anclote
360	1.2	1.8	0.5	Higgings & Anclote
70	0.1	0.2	5.5	Gannon, Highbridge, McKay Bay
80	4.8	5.5	4.2	Gannon, Highbridge
90	1.5	0.9	1.5	Bartow, Gannon, Highbridge
100	3.3	2.1	4.5	Bartow, Big Bend
110	0.1	0.4	0.01	Big Bend
120	10	29		Big Bend

TABLE II-7

DE MINIMIS IMPACTS
vs
MODELED IMPACTS
(ug/m^3)

Pollutant	De Minimis Level	Averaging Time	Modeled Impact
Carbon Monoxide	575	8 hr	14 (3 hr)
Nitrogen Dioxide	14	Annual	0.8
Particulate	10	24 hr	1.44
Sulfur Dioxide	13	24 hr	7.2
Lead	0.1	24 hr	0.24
Mercury	0.25	24 hr	0.024
Beryllium	5.0×10^{-4}	24 hr	2.4×10^{-5}
Fluoride	0.25	24 hr	0.24

Based on the above data, monitoring data is needed and will be supplied for lead.

The lead monitoring data will be supplied from the Sheriff's and Azalea Park monitoring stations. These stations are beyond the facilities's highest impact area but are located to record the highest lead levels expected within the county. This technique will distinguish the facility's highest impact added to the counties highest monitored level.

The ambient lead levels have fallen significantly in the past three years. The quarterly maximum have fallen from a high of 1.0 ug/m^3 in 1979 to 0.3 ug/m^3 in 1981. Table II-8 shows the highest quarterly average for the past three years.

TABLE II-8
AMBIENT LEAD CONCENTRATIONS
LEAD QUARTERLY MAXIMUMS
(mg/m^3)

Station	1979	1980	1981
Azalea Park	0.9	0.6	0.5
Sheriff's	1.0	0.5	0.3

It can be seen that the unit's highest 24-hr average level concentration (0.24 ug/m^3) added to the county's highest recorded quarterly average level in the past three years (1.0 ug/m^3) is still significantly below the NAAQS of 1.5 ug/m^3. Therefore, the facility will not violate the NAAQS for lead.

E. DOWN WASH ANALYSIS

As discussed earlier, the RRF stack will be 161 feet high which is 1.39 times the building height. The present rules governing Good Engineering Practice (GEP) stack heights would recommend a stack approximately 290 feet tall or 2.5 times the building height. A stack this tall would interfere with the operation of the Clearwater-St. Petersburg Airport. Due to the shortness of the stack a downwash or building wake problem could exist.

Huber & Snyder investigated the building wake effects on effluents from short stacks near a squat building. The Resource Recovery facility, due to its length to height ratio, represents a good example of a facility whose effluent could be adversely affected by building wake effects.

Huber & Snyder (H&S) developed a simple mathematical model to estimate the pollutant concentrations downwind of the building. This model was then tested against wind tunnel results. The model is a Gaussian type with standard dispersion parameters modified to account for enhanced dispersion in the building wake. The horizontal dispersion parameters (σ_y) and the vertical dispersion parameter (σ_z) are given by:

σ'_y = 0.35Hw + 0.067 x -3Hb, 3Hb $\leq$ x $\leq$ 10Hb

σ'_z = 0.7Hb + 0.067 (x-3Hb), 3Hb $\leq$ x $\leq$ 10Hb

where:

x = downstream distance
Hb = building height
Hw = building width

Thus:

	4Hb	9Hb
σ'_y =	31.2 m	43.0 m
σ'_z =	27.4 m	39.0 m

Distances of 4-9 Hb are representative of the range over which the H&S model is valid. The values for $_y$ and $_z$ are substituted into the Gaussian Plume equation:

$$\chi = \frac{Q}{2\pi\sigma_y\sigma_z u} \exp \frac{-y^2}{2\sigma_y} \exp \frac{-(z-Hp)^2}{2\sigma_z^2} + \exp \frac{-(z+Hp)^2}{2\sigma_z^2}$$

where:

Variable	Parameter	Value
H_b	building height	35.4 m
H_p	height to plume centerline	to be determined
Hs	stack height	49.1 m
Hw	building width	82.3 m
Q	emission rate	16.6 grams SO_2/sec
U	average wind speed	wind speed 0.7 Vs to 1.5 Vs
Vs	stack exist velocity	26.4 m/s
Y	Lateral Distance from center line	zero
Z	Height of receptor	zero

When z and y both equal zero the equation simplies to:

$$\chi = \frac{Q}{\pi\sigma_y\sigma_z u} \exp \frac{-H_p^2}{2\sigma_z^2}$$

Each of the above parameters are easily definable except H_p. The plume height is determined by the procedure shown below.

Plume Rise $$H_p = \left[\frac{Fm\ x^1}{B_j^2\ U_h^2} + \frac{3F\ x^{.2}}{2B_1^2\ U_h^3}\right]^{1/3}$$

Momemtum Flux	Fm	=	$\frac{(Ta/Ts)\ Vs^2\ d^2}{4} = 585.2\ m^4/sec^3$
Jet Entrainment Coefficient	Bj	=	$1/3 + \frac{Uh}{Vs}$
Bouyancy Flux	F	=	$\frac{F' = g\ Vs\ d^2}{4}(1. - Ta/Ts) = 154.8;$ $F' > Fc$
Momentum Causal Bouyancy Flux	Fc	=	$0.141\ (Vs\ d)^{5/3} = 142.6;$ $F' > 55m^4/sec^3$

Where:

Variable	Parameter	Value
X	distance downwind	$4H_b$ & $9H_b$, 141m & 318m
B_1	Correction Factor	0.6
Ta	ambient temperature	293^oK
Ts	stack/gas temperature	505^oK
Vs	stack/gas velocity	26.8 m/s
d	stack diameter	2.37 m
U	wind speed	.7 Vs, 1 Vs, 1.5 Vs

From the above equation we get the following values of plume rise (H_R)

Wind speed	.7 Vs	Vs	1.5 Vs
Downwind Distance		Plume Rise (H_R)	
$4\ H_b$	12.8 m	9 m	6 m
$9\ H_b$	21.6 m	15.2 m	10.1 m

The plume rise is from the top of the stack which gives H_b values of

Wind speed	.7 Vs	Vs	1.5 Vs
Downwind Distance		Plume Height (Hb)	
$4\ H_b$	61.9 m	58.1 m	55.1 m
$9\ H_b$	70.7 m	64.3 m	59.2 m

By substituting the above data into the simplified Gaussian Equation one gets

Wind speed	.7 Vs	Vs	1.5 Vs
Downwind Direction	Expected Concentration (ug/m^3)		
4 H_b	26	24.5	20
9 H_b	33	30	25

The above analysis was for a single unit thus the inpact for the RRF will be three times the above amounts. The third unit could be expected to give an occassional hot spot with a concentration of up to 30 ug/m^3. The RRF could cause an impact of up to 100 ug/m^3. The wind speed of 0.7 Vs equals 18.8 m/s. Five years of meteorological data (from 1974 through 1977) were searched and there are no days when the measured wind speed exceeded 17 m/s. ~ 38 mph Therefore gas flow downwash should not be a problem in this case.

F. INCREMENT CONSUMPTIONS

There are four facilities which have consumed part of the allowable increment; 1) the RRF Units 1 & 2, 2) the McKay Bay RRF, 3) TECO Big Bend, and 4) FPC Bartow. From the previous analysis the increment consumed by the RRF Units 1 & 2 and the McKay Bay RRF is known. An approximate increment can be assigned to TECO Big Bend due to their use of coal by proportioning the calculated SO_2 impacts by the increase in emissions. TECO Big Bend is permitted to emit 220,406 TPY of SO_2. TECO was granted a PSD permit to increase their emission of SO_2 by 11,949 Tons/yr or by 5 1/2%. TECO also had an "Insignificant Effect" on the particulate increment. The increment attributed to TECO Big Bend will be 5 1/2% of the impact modeled in section IID. Bartow's increment will be assumed to be that allowed by the DER in the Preliminary Determination on their coal conversion. Tables II-9 & II-10 show the incremental impact of each source.

G. CONTINUED COMPLIANCE

To demonstrate compliance with the final permits stack testing will be performed as required. The tests performed will be as requested by the DER and will be performed according to the procedures found in 40 C.F.R. Part 60 Appendix A.

TABLE II-9
SO_2 IMPACTS
INCREMENTAL AND ALLOWABLE

Source	3 hr ug/m³	%	24 hr ug/m³	%	Annual ug/m³	%
RRF No. 3	9	1.8	0.5	0.5	.05	0.3
RRF No. 1 & 2	17	3.3	1.0	1.1	.11	0.6
McKay Bay RRF	2.7	0.5	1.2	1.3	1 *	0.05
TECO Big Bend	13.7	2.7	6.1	6.7	3 **	0.15
FPC Bartow	0	0	0	0	0	0
Total	42.4	8.3	8.8	9.7	4.16	1.1
Allowable Increment	512		91		20	

* McKay Bay annual increment estimated from McKay Bay RRF permit application

** Conservatively estimated from 24 hr value.

TABLE II-10

PARTICULATE IMPACTS
INCREMENTAL AND ALLOWABLE

Source	24 hr ug/m3	%	Annual ug/m3	%
RRF No. 3	0.48	1.3	.05	0.3
RRF No. 1 & 2	0.96	2.6	.11	0.6
McKay Bay RRF	0.27	0.7	0.2	1.0
TECO Big Bend	0	0	0	0
FPC Bartow	25.9	70	3.2	17
Total	27.6	74.6	3.6	18.9
Allowable Increment	37		19	

* Conservatively estimated from 24 hr.

III. ADDITIONAL IMPACT ANALYSIS

A. PURPOSE

The basic purpose of the additional impacts analysis is to determine the effects of applicable criteria and noncriteria pollutant emissions on visibility, soils and vegetation. This assessment will be helpful in providing the Federal land manager with information regarding the potential impacts on Class I areas (Scenic areas, designated by Congress, to be protected from manmade air pollution, 33 U.S.C. 1288). In addition, this chapter of the air permit will help to inform the general public of potential impacts related air quality.

Three components of the additional impact analysis are: (1) a growth analysis, (2) a visibility impairment analysis, and (3) a soils and vegetation impact analysis. The final section of this chapter will summarize the results of these analyses.

B. GROWTH ANALYSIS

The Pinellas County Department of Planning estimates that the Pinellas County population will increase from the 1980 Census figure of 728,531 to 796,000 persons in 1985. This increase of approximately 68,000 people represents a 9% increase in five years or 1.8% per year. Future projections by the Department indicate an estimated population of 1,003,000 in the year 2000 which is a 38% increase over 20 years or an average of 1.6%/year.

The construction force is expected to range between 200 to 300 persons throughout the construction phase of the third unit. This represents less than 0.06% of the total population. It is expected that all of the construction work force except certain supervisory personnel will be from the local area. If there is any relocation of workers, housing is available in the vicinity of the proposed project. A sample of the types and numbers of construction workers is shown in Table III-1.

The operation of the proposed facility will require approximately 6 additional persons. A sample of the types and numbers of operations personnel is shown in Table III-2. It is expected that these personnel will also be from the local area.

The implementation of the proposed facility will cause a positive economic impact on Pinellas County because most, if not all, of the construction and operations work forces will be from the local community. Since there will not be a major influx of workers into the area, there will a minimal impact on the environmental quality of the community due to growth in the area's work force or secondary construction caused by the facility.

TABLE III-1

ESTIMATED CONSTRUCTION WORK FORCE
1050-TPD UNIT

Types	Work Force
Boilermakers	50
Carpenters	30
Electricians	15
Ironworkers	40
Laborers	50
Masons	15
Millwrights	25
Painters	5
Pipefitters	20
Total	250

TABLE III-2

ESTIMATED ADDITIONAL OPERATIONAL STAFF
1050 TPD UNIT

Types	Work Force
Supervisory	0
Clerical	1
Operators per shift	3
Maintenance	2
Security	0
Janitorial	0
Total	6

C. VISIBILITY ANALYSIS

The Clean Air Act Amendments of 1977 require evaluation of new and existing emission sources to determine potential impacts on visibility in Class 1 areas. These source evaluations are to be used as part of a regulatory program to prevent future and remedy existing impairment of visibility in Class 1 areas that results from man-made air pollution. The visibility analysis discussed below is taken from EPA's "Workbook for Estimating Visibility Impairment", November, 1980, which provides a general guidance for determining the potential impacts of an emissions source on visibility in a Class 1 area.

There are two separate types of visibility impairment: atmospheric discoloration and visual range reduction (increased haze); see Figure 1. EPA has defined "visibility impairment" to mean any humanly perceptible change in visibility (visual range, contrast, coloration) from that which would have existed under natural conditions. An important part of a visibility analysis is to determine the frequency of occurrence and magnitude of visual impact in, or within view of, a Class 1 area.

A schematic of EPA's recommended visibility screening analysis procedure is shown in Figure 2. A Level 1 analysis has been performed and is included in Appendix B. The input data included in the analysis estimated NO_2, SO_2 and the particulate emissions for the proposed resource recovery facility. Regional visual range and distance to the nearest Class 1 areas were used. The nearest Class I area is the Chassahowitzka National Wildlife refuge, located on the west coast of Florida, 75 miles north of the site. A plume contrast rating load was established with reference to the sky, the terrain and the primary and secondary aerosols. EPA has established a rating factor for the plume contrasts which provides guidance for determination of further analysis. If the calculated plume contrast is less than 0.1, no further analyses of potential visibility impacts are necessary. The absolute values of each plume contrast for the proposed facility were calculated to be less than 0.001, which is less than the EPA rating factor. Therefore, further analyses of potential visibility impacts are unnecessary, as it is considered highly unlikely that the proposed facility would cause adverse visibility impairment in Class 1 areas.

D. SOILS AND VEGETATION ANALYSIS

The electrostatic precipitators and the stack height of the proposed Facility will be designed so that neither Florida Ambient Air Quality Standards (FAAQS) nor the PSD increments will be violated. The facility will not violate the secondary FAAQS's, estalished to protect vegetation, materials, visibility, etc. The secondary standards for CO, NO_x, O_3 and HC are equivalent to their respective primary standards, as can be seen in Table III-3. The secondary standards for TSP and SO_2 are more stringent than their respective primary standards.

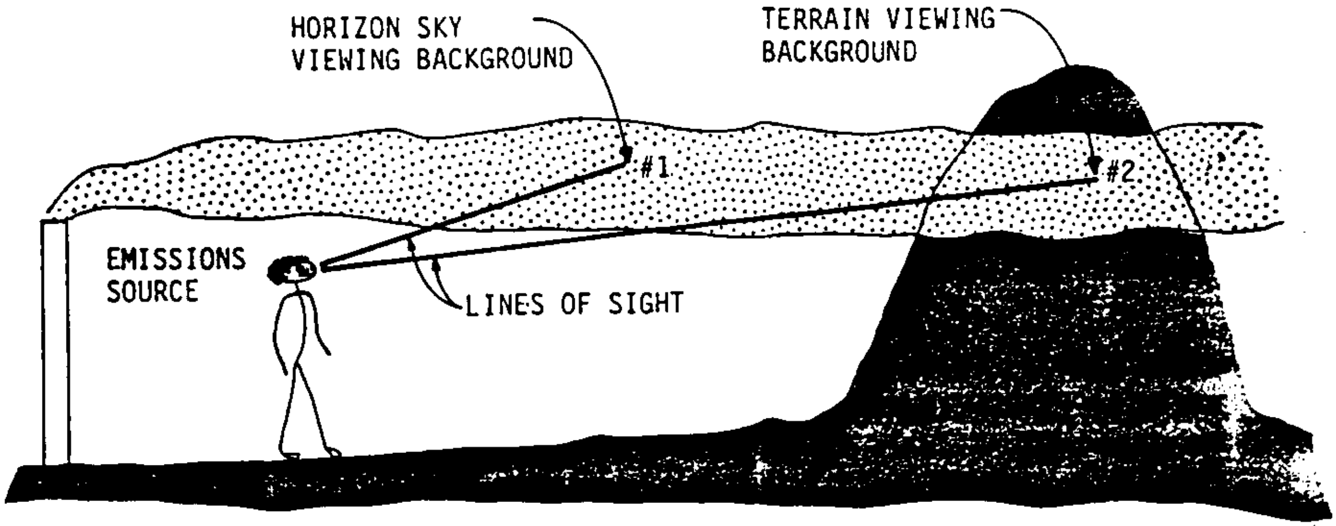


Figure 10. Two types of plume visibility impairment considered in the level-1 visibility screening analysis.

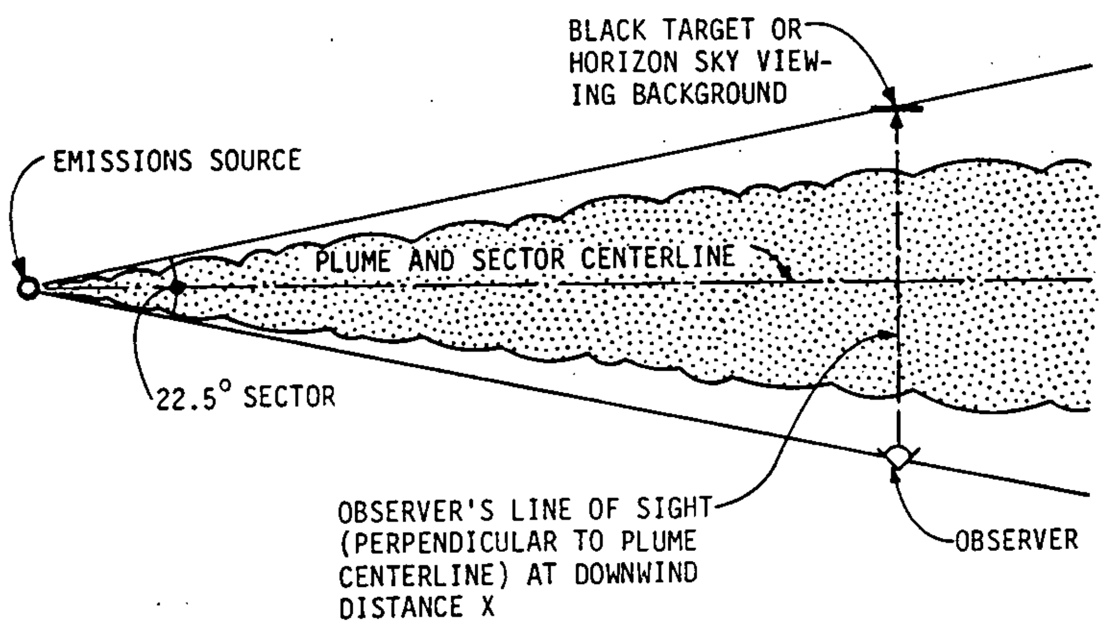


Figure 11. Geometry of plume, observer, and line of sight used in level-1 visibility screening analysis.

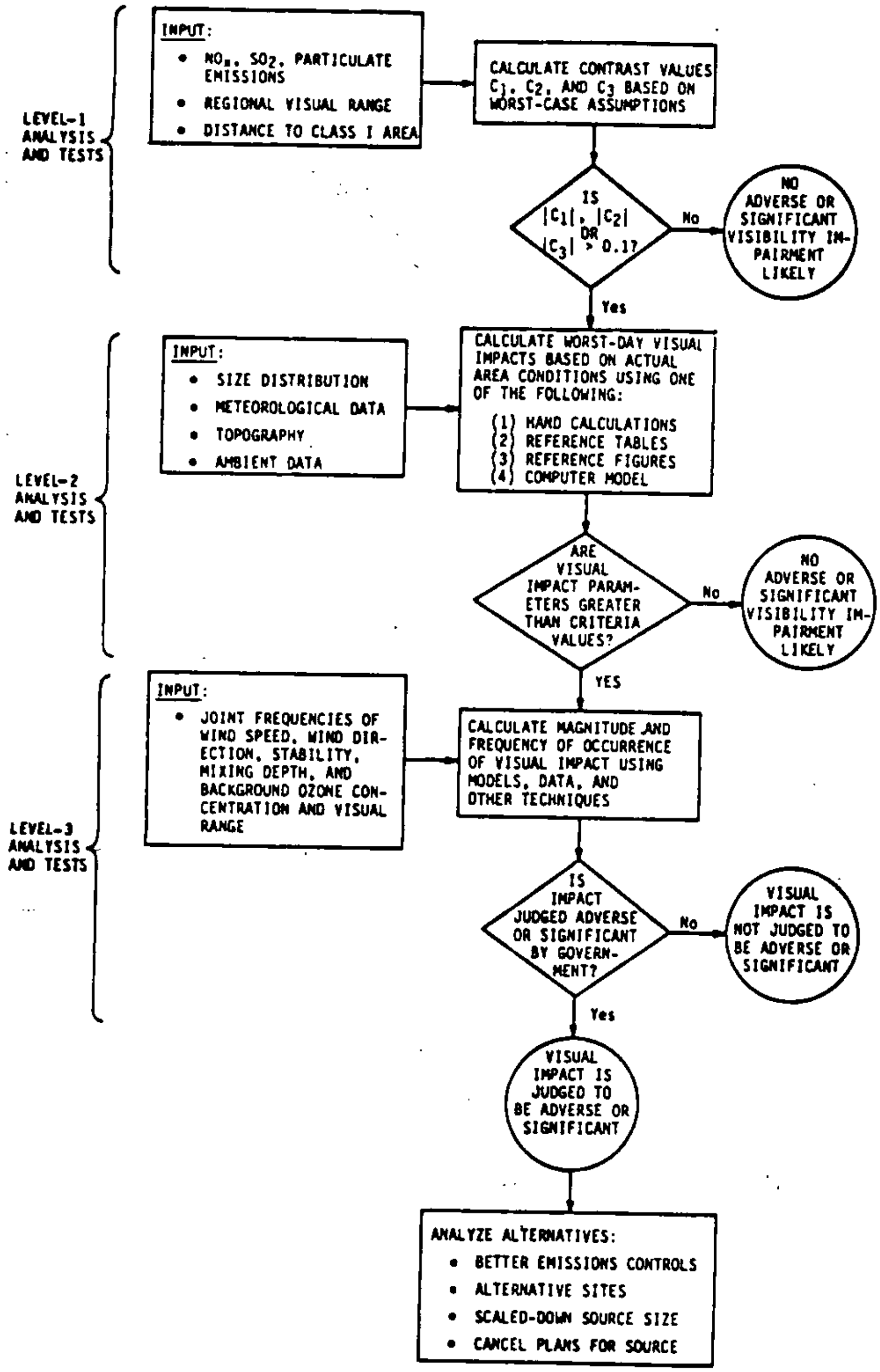


Figure 1. Schematic of visibility screening analysis procedure. The numerical meaning of the terms "significant" and "adverse" differ on a case-by-case basis and will be defined after an in-depth policy analysis of each case.

TABLE III-3
FLORIDA AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time[1]	Primary Standards	Secondary Standards
Particulate matter	Annual geometric mean 24-hour	75 ug/m^3 260 ug/m^3	60 ug/m^3 150 ug/m^3
Sulfur oxides	Annual arithmetic mean	80 ug/m^3 (0.03 ppm)	--- 60 ug/m^3
	24-hour	365 ug/m^3 (0.14 ppm)	--- 260 ug/m^3
	3-hour	---	1300 ug/m^3 (0.5 ppm)
Carbon monoxide	8-hour	10 mg/m^3 (9 ppm)	same
	1-hour	40 mg/m^3 (35 ppm)	same
Nitrogen dioxide	Annual arithmetic mean	100 ug/m^3 (0.05 ppm)	same
Ozone	1-hour	240 ug/m^3 (0.12 ppm)	same
Lead	Calendar quarter	1.5 ug/m^3	same

1. The 1-, 3-, 8-, or 24-hour standards are not to be exceeded more than once per year.

1. Soils

The air pollutants from a major stationary source could alter soil characteristics, which may affect vegetation in the area. Vegetation can also be affected directly by acid rain, the result of SO_2 and NO_x emissions. There are pollutant levels at which soils and vegetation are not affected. In fact, the soil is a natural sink for many pollutants such as CO. Soils in the temperate zone have been estimated to remove and assimilate, on the average, 8.44 mg of CO/hr/m^2 from the atmosphere (Inman and Ingersoll, 1971). Particulate matter that drops out of the atmosphere and into the soil is generally recycled as nutrients or fixed in a form that is unavailable to vegetation (Bonn, 1972, Rasmussen, et al., 1975).

Pollutants such as fluoride, mercury and beryllium are absorbed by soil and generally fixed by the organic and clay fractions of the soil.

Therefore, the pollutants would be in a form unavailable to plants. The tolerance of soils and plants is dependent on the soil type and plant species.

The most serious impact on soil would be caused by acid rain, which could increase the soil acidity and increase nutrient leaching rates. It appears unlikely that increasing annual ambient levels by 0.8 ug/m^3 of SO_2 and 0.8 ug/m^3 of NO_2 that the proposed facility would measureably alter long-term precipitation pH levels. In fact, no accurate estimation of the change in the pH of rainfall caused by the proposed facility is feasible within current state-of-the-art technology.

2. Vegetation

Native vegetation in the study is associated with specifc soil classifications. In areas of urban or agriculatural usage, non-native species have invaded or are cultivated. Table III-4 features a compilation of soil and vegetation communities found in the area.

In residential areas plantings of various ornamental species are common; also prevalent, especially in less dense residential subdivisions are backyard gardens. In vacant lots where the native vegetation has been removed, thick coppices of Brazilian pepper are found. Fringing the snores of Tampa Bay are stamps of Black Mangrove.

Table III-5 is a compilation of landscape, agricultrual and other non-native species observed in the study area. This listing presents only those speciments which commonly occur.

Backyard gardens range from several square feet to an acre in size. The local climate allows for year round planting although tender plants are generally sown in spring only. Vegetables grown include corn, beans (bush, pole, lima, and pinto), peas (English and southern), greens (collards, mustard, lettuce, cabbage, celery), tomatoes, okra, carrots, turnips, broccoli, cauliflower, eggplant, and peppers. The most common fruit are strawberries; garden specimens of citrus and avacado are not uncommon.

The land within the study area to the south and east characterized by urban usage and resultant landscape plantings. Immediately surrounding the facility site on disturbed open land are dense coppices of brazilian pepper. The tidal shoreline is fringed by black and red mangroves although the former species is more common. Severe freeze damage to the mangroves and many other tender exotics (e.g. Australian pine, cajeput) resulted from an unusually cold period during January, 1981. A few small citrus groves were identified in the far north portion of the study area.

TABLE III-4
SOIL AND VEGETATION COMMUNITIES

Soil Classification	Associated Major Community Species
Well drained deep sands	turkey oak, bluejack oak, slash pine, dogwood, hickory
Poorly drained sands over organic hardpans	pine flatwoods (slash pine, palmetto, wire grass)
Poorly drained sands over calcareous substrate	sabal palm, saw palmetto and wire grass
Well drained sands with phosphatic materials	live and laurel oaks, hickory, and pines
Tidal lands	white, black and red mangrove and black needlerush
Freshwater swamps	pond and bald cypress and sweet bay
Poorly drained acid sands	pine flatwoods (slash pine, palmetto, and wire grass)
Poorly drained neutral to alkaline soils	slash pine, water oaks, and sweet bay
Poorly drained dark colored sands	pine flatwoods (slash pine, palmetto, and wire grass)
Urban lands	landscape plantings and backyard gardens; commercial/industrial open land is covered by Brazilian pepper
Agricultural lands	pasture land of bahia grass; some citrus groves (oranges, grapefruit)

TABLE III-5
LANDSCAPE, AGRICULATURE AND OTHER
NON-NATIVE SPECIES

Common Name	Genus	Species	Location
Grasses			
Baniagrass	Paspalum	notatum	Pastures and lawns
Bermudagrass	Cynodon	dactylon	lawns
St. Augustine Grass	Stenotaphrum	secundatum	lawns (most common lawn grass
Wire Grass	Aristida	stricta	native; pine flatwoods
Panic Grass	Panicum	sp.	native; on disturbed sites
Ground Coverings			
Periwinkle	Vinca	spp	native; disturbed sites and landscape plantings
Lily-turn	Liriope	muscari	landscape plantings
Flowers			
Chrysanthemum	Chrysanthemum	indicum	landscape plantings
Begonia	Begonia	sp	landscape plantings & hanging baskets
Geranium	Pelargonium	sp	landscape plantings
Marigold	Tagetes	spp	landscape plantings
Phlox	Phlox	drummondi	native; along roads and railroad tracks
Rose	Rosa	spp	landscape plantings
Bulbs			
Day-lily	Hemerocallis	sp	landscape plantings
Canna lily	Canna	sp	landscape plantings
Ferns			
Asparagus Fern	Asparagus	sp	hanging baskets and window pots
Succulents			
Spanish Bayonet	Yucca	aloifolia	native; landscape plantings and along roadways
Century Plant	Agave	americana	landscape plantings

TABLE III-5 (Continued)

Common Name	Genus	Species	Location
Palms			
Cabbage palm	Sabal	palmetto	native; prairies and landscape plantings (state fee)
Areca palm	Chrysali-docarpus	lutescens	landscape plantings
Canary Island data palm	Phoenix	canariensis	landscape plantings
Coconut palm	Cocos	nucifera	landscape plantings
Manila palm	Veitchia	merrillii	landscape plantings
Queen palm	Arecastrum	romanzof-fianum	landscape plantings
Native Trees			
Slash Pine	Pinus	elliottii	pine flatwoods, swamps, & left on developed land
Longleaf Pine	Pinus	palustris	on drier sites and in landscapes
Live Oak	Quercus	virginiani	better, dry soils and landscapes
Water Oak	Quercus	nigra	poorly trained sites
Red Cedar	Juniperus	silicicola	soils underlain by calcareous material and landscapes
Sweet Gum	Liquidambar	styraciflua	poorly drained sands and loams
Sweet Bay	Magnolia	virginiana	poorly drained acid sands
Turkey Oak	Quercus	laevis	excessively drained sands
Bluejack Oak	Quercus	incana	execeesively drained sands
Bald cypress	Taxodium	disthichum	riverine swamps
Pond cypress	Taxodium	ascendens	cypress domes and depressed lands among pine flatwoods along ditches and streams
Black mangrove	Avicennia	nitida	tidal swamps
Red mangrove	Rhizophora	mangle	tidal swamps seaward of black mangrove
Hickory	Carya	sp	mesic forests

TABLE III-5 (Continued)

Common Name	Genus	Species	Location
Native Shrubs			
Saw palmetto	Serenoa	sp	pine flatwoods and deep sands
Yaupon holly	Ilex	vomitoria	deep sands and landscapes
Gallberry	Ilex	coriacea	pine flatwoods
Wax myrtle	Myrica	cerifera	pine flatwoods
Exotic Species			
Australian Pine	Casuarina	spp	along roads and property lines
Citrus	Citrus	spp	oranges, grapefruits, lines, lemons, and tangerines in backyards or small groves
Jerusalem thorn	Parkinsonia	aculeata	disturbed open land and landscapes
Norfolk Island pine	Araucaria	excelsa	landscape plantings
Cajeput	Melaleuca	leucadendra	disturbed open land
Rubber tree	Ficus	sp.	landscape plantings
Banana	Musa	spp	landscape plantings
Bambòo	Bambusa	sp.	landscape plantings
Sago palm	Cycas	revoluta	landscape plantings
Pampas grass	Cortaderia	sellonna	landscape plantings
Copper leaf	Acalypha	wilkesiana	landscape plantings
Croton	Cordiaeum	Variegatum	landscape plantings
Hibiscus	Hibiscus	spp.	landscape plantings
Oleander	Nerium	oleander	landscape plantings
Surinam cherry	Eugenia	unifloria	landscape plantings
Brazilian pepper			grows in dense thickets on disturbed open land.

E. SENSITIVE ZONES

The area immediately surrounding the facility consists of open disturbed lands (created by recent construction) with some warehouse and other light manufacturing structures. The water body just east of this fill area is Tampa Bay, an emergent, or man-impacted ecosystem; it is the focal point of many area conservation groups primarily in conjunction with nesting and/or migratory bird populations. The mangrove ecosystem fringing tidal shores are important natural assets from both a fisheries and storm protection standpoints.

Tree species, such as black and red oak, white pine, gray and white birch, American elm and red maple, have been reported to be relatively sensitive to ambient SO_2 levels (Jones, et al., 1974, Davis and Wilhour, 1976). Concentrations of SO_2 between 786 and 1,572 ug/m^3 for three hours have developed visible injury symptoms (Jones, et al., 1974). White pines exposed to ambient SO_2 levels of more than 0.25 ppm are often stunted (Linzon, 1966). Maximum annual SO_2 concentrations are predicted to be less than 35 ug/m^3, which is considered to be below the threshold at which injury to even sensitive woody vegetation may occur (NAS, 1978).

Long-term exposure to 470 ug/m^3 NO_2 throughout the months of the growing season has been found to reduce growth, weight and yield in tomato plants (Spiering, 1971). However, the predicted peak annual ambient NO_2 concentration of 0.8 ug/m^3 will be well below the minimum concentration reported to cause injury to vegetation after long-term exposures.

Only small increases of ambient TSP levels, 1.44 ug/m^3 and 0.16 ug/m^3 for the 24-hour and annual averages will be caused by the proposed facility. These small increases will not be sufficient to coat foliage or block light and gas exchange (Lodge, et al., 1981).

Vegetation is extremely resistant to CO. In fact, plants exposed to 115 mg/m^3 CO for up to three weeks did not produce any visible injury (Zimmerman, et al., 1933). Predicted maximum CO levels in the vicinity of the proposed facility is 14 ug/m^3, per 8-hour interval.

Ambient lead levels are predicted to be less than 0.24 ug/m^3 for a calendar quarter. The proposed facility will contribute approximately 17% of the ambient standard. However, there have been no known reports of injury to vegetation from lead concentrations near highways where lead concentrations are expected to be high (NRC, 1979).

Plants can be particularly sensitive to fluoride emissions, especially as hydrofluoric acid. However, most of the fluoride emissions from the proposed plant will be in the form of an aerosol (suspended fine particulates), which is less damaging to vegetation. Fluorides can cause spotting or partial destruction of leaf surfaces and reduced plant growth.

Total ambient fluoride levels of 0.8 to 4.0 ug/m^3 for several days have been shown to adversely affect the most fluoride-sensitive plants, such as corn, cherry pine and gladiolus (Treshow, 1969). However, when gladiolus plants were exposed to average fluoride aerosol averaging levels of 1.9 ug/m^3 for four weeks, no damage to leaf areas was experienced (Pack, et al., 1960).

The proposed facility may have peak 24-hour averaging fluoride levels of 0.24 ug/m^3 in the immediate vicinity of the plant.

F. SUMMARY

There will be a positive economic impact on Pinellas County due to the implementation of the proposed facility, while environmental impacts will be slight. Workers for the construction and operation of the facility will be from the local work force; therefore, no growth impacts would be experienced due to an influx of workers from outside the county.

The Class 1 areas closest to the proposed facility are about at a 75 kilometers from the facility. A level 1 visibility analysis indicated that it is extremely unlikely that visibility would be affected in these areas.

The soils in Pinellas County have sufficient high clay content to resist acid precipitation, and should be good at absorbing pollutants such as particulate matter, fluoride, mercury and beryllium. Any increase in SO_2 or NO_2 due to the proposed facility should not significantly alter the pH of rainfall. In fact, any pH change experienced would not be measurable. Increased ambient levels of criteria and non-criteria pollutants due to the facility emissions are not likely to have a significant effect on vegetation in the area.

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AIR PERMIT APPLICATION FORMS

APPENDIX A

VISIBILITY ANALYSIS

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

APPLICATION TO OPERATE/CONSTRUCT AIR POLLUTION SOURCES

SOURCE TYPE: Incinerator [X] New[1] [ ] Existing[1]

APPLICATION TYPE: [X] Construction [ ] Operation [ ] Modification

COMPANY NAME: Pinellas County COUNTY: Pinellas

Identify the specific emission point source(s) addressed in this application (i.e. Lime Kiln No. 4 with Venturi Scrubber; Peeking Unit No. 2, Gas Fired) Incinerator

SOURCE LOCATION: Street 28th SE & 110th Avenue City County

UTM: East ______ North ______

Latitude 27 ° 52 ' - "N Longitude 82 ° 40 ' - "W

APPLICANT NAME AND TITLE: Pinellas County, Dept. of Public Works & Utilities

APPLICANT ADDRESS: 310 Court Street, Clearwater, Florida 33516

SECTION I: STATEMENTS BY APPLICANT AND ENGINEER

A. APPLICANT

I am the undersigned owner or authorized representative* of Pinellas County

I certify that the statements made in this application for a Construction Permit permit are true, correct and complete to the best of my knowledge and belief. Further, I agree to maintain and operate the pollution control source and pollution control facilities in such a manner as to comply with the provision of Chapter 403, Florida Statutes, and all the rules and regulations of the department and revisions thereof. I also understand that a permit, if granted by the department, will be non-transferable and I will promptly notify the department upon sale or legal transfer of the permitted establishment.

*Attach letter of authorization

Signed: ______

D. F. Acenbrack, Director
Name and Title (Please Type)

Date: ______ Telephone No. ______

B. PROFESSIONAL ENGINEER REGISTERED IN FLORIDA (where required by Chapter 471, F.S.)

This is to certify that the engineering features of this pollution control project have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the treatment and disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgment, that the pollution control facilities, when properly maintained and operated, will discharge an effluent that complies with all applicable statutes of the State of Florida and the rules and regulations of the department. It is also agreed that the undersigned will furnish, if authorized by the owner, the applicant a set of instructions for the proper maintenance and operation of the pollution control facilities and, if applicable, pollution sources.

Signed: ______

Robert Van Deman
Name (Please Type)

(Affix Seal)

Henningson, Durham & Richardson, Inc.
Company Name (Please Type)

P.O. Box 5576, Clearwater, Florida 33518
Mailing Address (Please Type)

Florida Registration No. ______ Date: ______ Telephone No. ______

[1]See Section 17-2.02(15) and (22), Florida Administrative Code, (F.A.C.)

SECTION II: GENERAL PROJECT INFORMATION

A. Describe the nature and extent of the project. Refer to pollution control equipment, and expected improvements in source performance as a result of installation. State whether the project will result in full compliance. Attach additional sheet if necessary.

Addition of third combustion to existing facility. Advantages will be greater availability of energy production. Electrostatic precipitators will be used to control particulate.

B. Schedule of project covered in this application (Construction Permit Application Only)

Start of Construction August 1983 Completion of Construction August 1986

C. Costs of pollution control system(s): (Note: Show breakdown of estimated costs only for individual components/units of the project serving pollution control purposes. Information on actual costs shall be furnished with the application for operation permit.)

D. Indicate any previous DER permits, orders and notices associated with the emission point, including permit issuance and expiration dates.

DER Powerplant Site Certification PA 78-11

E. Is this application associated with or part of a Development of Regional Impact (DRI) pursuant to Chapter 380, Florida Statutes, and Chapter 22F-2, Florida Administrative Code? ____ Yes X No

F. Normal equipment operating time: hrs/day 24 ; days/wk 7 ; wks/yr 52 ; if power plant, hrs/yr 8760 ; if seasonal, describe:

G. If this is a new source or major modification, answer the following questions. (Yes or No)

1. Is this source in a non-attainment area for a particular pollutant? Yes
   a. If yes, has "offset" been applied? No
   b. If yes, has "Lowest Achievable Emission Rate" been applied? No
   c. If yes, list non-attainment pollutants. Ozone
2. Does best available control technology (BACT) apply to this source? If yes, see Section VI. Yes
3. Does the State "Prevention of Significant Deterioriation" (PSD) requirements apply to this source? If yes, see Sections VI and VII. Yes
4. Do "Standards of Performance for New Stationary Sources" (NSPS) apply to this source? Yes
5. Do "National Emission Standards for Hazardous Air Pollutants" (NESHAP) apply to this source? Yes

Attach all supportive information related to any answer of "Yes". Attach any justification for any answer of "No" that might be considered questionable.

SECTION III: AIR POLLUTION SOURCES & CONTROL DEVICES (Other than Incinerators)

A. Raw Materials and Chemicals Used in your Process, if applicable:

Description	Contaminants		Utilization Rate - lbs/hr	Relate to Flow Diagram
	Type	% Wt		

B. Process Rate, if applicable: (See Section V, Item 1)

1. Total Process Input Rate (lbs/hr): ______

2. Product Weight (lbs/hr): ______

C. Airborne Contaminants Emitted:

Name of Contaminant	Emission[1]		Allowed Emission[2] Rate per Ch. 17-2, F.A.C.	Allowable[3] Emission lbs/hr	Potential Emission[4]		Relate to Flow Diagram
	Maximum lbs/hr	Actual T/yr			lbs/hr	T/yr	

D. Control Devices: (See Section V, Item 4)

Name and Type (Model & Serial No.)	Contaminant	Efficiency	Range of Particles[5] Size Collected (in microns)	Basis for Efficiency (Sec. V, It[5]

[1]See Section V, Item 2.

[2]Reference applicable emission standards and units (e.g., Section 17-2.05(6) Table II, E. (1), F.A.C. – 0.1 pounds per million BTU heat input)

[3]Calculated from operating rate and applicable standard

[4]Emission, if source operated without control (See Section V, Item 3)

[5]If Applicable

E. Fuels

Type (Be Specific)	Consumption*		Maximum Heat Input (MMBTU/hr)
	avg/hr	max./hr	

*Units Natural Gas, MMCF/hr; Fuel Oils, barrels/hr; Coal, lbs/hr

Fuel Analysis:

Percent Sulfur: ______ Percent Ash: ______

Density: ______ lbs/gal Typical Percent Nitrogen: ______

Heat Capacity: ______ BTU/lb ______ BTU/gal

Other Fuel Contaminants (which may cause air pollution): ______

F. If applicable, indicate the percent of fuel used for space heating. Annual Average ______ Maximum ______

G. Indicate liquid or solid wastes generated and method of disposal.

H. Emission Stack Geometry and Flow Characteristics (Provide data for each stack):

Stack Height: ______ ft. Stack Diameter: ______ ft.

Gas Flow Rate: ______ ACFM Gas Exit Temperature: ______ °F.

Water Vapor Content: ______ % Velocity: ______ FPS

SECTION IV: INCINERATOR INFORMATION

Type of Waste	Type O (Plastics)	Type I (Rubbish)	Type II (Refuse)	Type III (Garbage)	Type IV (Pathological)	Type V (Liq & Gas By-prod.)	Type VI (Solid By-prod.)
Lbs/hr Incinerated approx.	8% 7000	24% 21000	40% 35000	10% 8750	0	0	18% 15750

Description of Waste Municipal Solid Waste

Total Weight Incinerated (lbs/hr) 87500 Design Capacity (lbs/hr) 87500

Approximate Number of Hours of Operation per day 24 days/week 7

Manufacturer UOP

Date Constructed ______ Model No. ______

	Volume (ft)^3	Heat Release (BTU/hr)	Fuel		Temperature (°F)
			Type	BTU/hr	
Primary Chamber	Na	4.11×10^8 Btu/hr	Solid Waste	4.11×10^8 Btu/hr	1600-1800°F
Secondary Chamber					

Stack Height: 161 ft. Stack Diameter 7.78bf Stack Temp. 450°F

Gas Flow Rate: 251,000 ACFM ______ DSCFM* Velocity 88 FPS

*If 50 or more tons per day design capacity, submit the emissions rate in grains per standard cubic foot dry gas corrected to 50% excess air.

Type of pollution control device: [ ] Cyclone [ ] Wet Scrubber [ ] Afterburner [X] Other (specify) ESP

Brief description of operating characteristics of control devices:

Electrostatic collection of particulate matter

Ultimate disposal of any effluent other than that emitted from the stack (scrubber water, ash, etc.):

solids to landfill

liquids to sewer

SECTION V: SUPPLEMENTAL REQUIREMENTS

Please provide the following supplements where required for this application.

1. Total process input rate and product weight – show derivation.

2. To a construction application, attach basis of emission estimate (e.g., design calculations, design drawings, pertinent manufacturer's test data, etc.,) and attach proposed methods (e.g., FR Part 60 Methods 1, 2, 3, 4, 5) to show proof of compliance with applicable standards. To an operation application, attach test results or methods used to show proof of compliance. Information provided when applying for an operation permit from a construction permit shall be indicative of the time at which the test was made.

3. Attach basis of potential discharge (e.g., emission factor, that is, AP42 test).

4. With construction permit application, include design details for all air pollution control systems (e.g., for baghouse include cloth to air ratio; for scrubber include cross-section sketch, etc.).

5. With construction permit application, attach derivation of control device(s) efficiency. Include test or design data. Items 2, 3, and 5 should be consistent: actual emissions = potential (1-efficiency).

6. An 8½" x 11" flow diagram which will, without revealing trade secrets, identify the individual operations and/or processes. Indicate where raw materials enter, where solid and liquid waste exit, where gaseous emissions and/or airborne particles are evolved and where finished products are obtained.

7. An 8½" x 11" plot plan showing the location of the establishment, and points of airborne emissions, in relation to the surrounding area, residences and other permanent structures and roadways (Example: Copy of relevant portion of USGS topographic map).

8. An 8½" x 11" plot plan of facility showing the location of manufacturing processes and outlets for airborne emissions. Relate all flows to the flow diagram.

9. An application fee of $20, unless exempted by Section 17-4.05(3), F.A.C. The check should be made payable to the Department of Environmental Regulation.

10. With an application for operation permit, attach a Certificate of Completion of Construction indicating that the source was constructed as shown in the construction permit.

SECTION VI: BEST AVAILABLE CONTROL TECHNOLOGY

A. Are standards of performance for new stationary sources pursuant to 40 C.F.R. Part 60 applicable to the source?
[X] Yes [ ] No

Contaminant	Rate or Concentration
Particulate	0.08 gr / dscf @ 12% CO_2

B. Has EPA declared the best available control technology for this class of sources (If yes, attach copy) [ ] Yes [X] No

Contaminant	Rate or Concentration

C. What emission levels do you propose as best available control technology?

Contaminant	Rate or Concentration
Particulate	0.03 gr / dscf at 12% CO_2

D. Describe the existing control and treatment technology (if any).

1. Control Device/System: NONE
2. Operating Principles:
3. Efficiency:*
4. Capital Costs:
5. Useful Life:
6. Operating Costs:
7. Energy:
8. Maintenance Cost:
9. Emissions:

Contaminant	Rate or Concentration

*Explain method of determining D 3 above.

10. Stack Parameters

a. Height: ft. b. Diameter: ft.

c. Flow Rate: ACFM d. Temperature: °F

e. Velocity: FPS

E. Describe the control and treatment technology available (As many types as applicable, use additional pages if necessary).

1.

a. Control Device: SEE BACT SECTION

b. Operating Principles:

c. Efficiency*: d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy*: h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

2.

a. Control Device:

b. Operating Principles:

c. Efficiency*: d. Capital Cost:

e. Useful Life: f. Operating Cost:

g. Energy**: h. Maintenance Costs:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

*Explain method of determining efficiency.

**Energy to be reported in units of electrical power — KWH design rate.

3.

a. Control Device:

b. Operating Principles:

c. Efficiency*: d. Capital Cost:

e. Life: f. Operating Cost:

g. Energy: h. Maintenance Cost:

*Explain method of determining efficiency above.

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space and operate within proposed levels:

4.

a. Control Device

b. Operating Principles:

c. Efficiency*:

d. Capital Cost:

e. Life:

f. Operating Cost:

g. Energy:

h. Maintenance Cost:

i. Availability of construction materials and process chemicals:

j. Applicability to manufacturing processes:

k. Ability to construct with control device, install in available space, and operate within proposed levels:

F. Describe the control technology selected:

SEE BACT SECTION

1. Control Device:
2. Efficiency*:
3. Capital Cost:
4. Life:
5. Operating Cost:
6. Energy:
7. Maintenance Cost:
8. Manufacturer:
9. Other locations where employed on similar processes:

a.

(1) Company:

(2) Mailing Address:

(3) City:

(4) State:

(5) Environmental Manager:

(6) Telephone No.:

*Explain method of determining efficiency above.

(7) Emissions*:

Contaminant	Rate or Concentration

(8) Process Rate*:

b.

(1) Company:

(2) Mailing Address:

(3) City:

(4) State:

*Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

(5) Environmental Manager:

(6) Telephone No.:

(7) Emissions*:

Contaminant	Rate or Concentration

(8) Process Rate*:

10. Reason for selection and description of systems:

*Applicant must provide this information when available. Should this information not be available, applicant must state the reason(s) why.

SECTION VII – PREVENTION OF SIGNIFICANT DETERIORATION

A. Company Monitored Data

1. ________ no sites None TSP ( ) SO^2* ________ Wind spd/dir

Period of monitoring __/__/__ (month day year) to __/__/__ (month day year)

Other data recorded Pinellas County Dept. of Environmental Management

Attach all data or statistical summaries to this application.

2. Instrumentation, Field and Laboratory

a) Was instrumentation EPA referenced or its equivalent? X Yes ____ No

b) Was instrumentation calibrated in accordance with Department procedures? X Yes ____ No ____ Unknown

B. Meteorological Data Used for Air Quality Modeling

1. 5 Year(s) of data from 1 / / 70 (month day year) to 12 / 31 / 74 (month day year)

2. Surface data obtained from (location) Tampa

3. Upper air (mixing height) data obtained from (location) Tampa

4. Stability wind rose (STAR) data obtained from (location) ________

C. Computer Models Used

1. CRSTER Modified? If yes, attach description.

2. PTP/U Modified? If yes, attach description.

3. PTDIS Modified? If yes, attach description.

4. ________ Modified? If yes, attach description.

Attach copies of all final model runs showing input data, receptor locations, and principle output tables.

D. Applicants Maximum Allowable Emission Data

Pollutant	Emission Rate
TSP	________ grams/sec
SO^2	________ grams/sec

E. Emission Data Used in Modeling

Attach list of emission sources. Emission data required is source name, description on point source (on NEDS point number), UTM coordinates, stack data, allowable emissions, and normal operating time.

F. Attach all other information supportive to the PSD review.

*Specify bubbler (B) or continuous (C).

G. Discuss the social and economic impact of the selected technology versus other applicable technologies (i.e., jobs, payroll, production, taxes, energy, etc.). Include assessment of the environmental impact of the sources.

The project will create jobs and decrease need for landfill space.

H. Attach scientific, engineering, and technical material, reports, publications, journals, and other competent relevant information describing the theory and application of the requested best available control technology.

Level I Visibility Analysis

Ref. EPA 450/4-8-031 Nov 80
"Workbook for Estimating
Visibility Impairment."

Q = Pinellas Co. RRF Units 1, 2 + 3

Q_{part} = 1.81 metric tons/Day particulate
Q_{NO_2} = 4.31 metric tons/Day NO_x
Q_{SO_2} = 4.31 metric tons/Day SO_2

x = 75 km to Chassahowitzka Nat Wildlife Area

σ_z = 90 m vertical dispersion coefficient

Plume Dispersion Parameter

$$P = \frac{2.0\times10^5}{\sigma_z x} = \frac{2\times10^8}{90 \cdot 75} = 2.96\times10^4$$

τ_{part} = Optical Thickness

$\tau_{part} = 10\times10^{-7} Q_{part} = (10\times10^{-7})(2.96\times10^4)(1.81)$
τ_{part} = ~~1.23×10^-3~~ 5.36×10^{-2}

$\tau_{NO_2} = 1.7\times10^{-7}\, P\, Q_{NO_2} = 1.7\times10^{-7}(2.96\times10^4)(4.31)$
$\tau_{NO_2} = 2.17\times10^{-2}$

r_{vo} = 25 km regional background visual range (Figure 13)

HDR

Project: Pinellas RRF — Computed: [illegible]
Subject: Visibility Analysis — Date: 2/28/83 — Sht. 2 of 3

$\tau_{aerosol}$ – Primary + Secondary Aerosol

$$\tau_{ar} = 1.06 \times 10^{-5}\, r_{vo}\, (Q_{part} + 1.31\, Q_{SO_2})$$
$$\tau_{ar} = (1.06 \times 10^{-5})(25)(1.81 + 1.31(4.31))$$
$$\tau_{ar} = 1.98 \times 10^{-3}$$

C_1 = Plume Contrast / Sky

$$C_1 = \frac{-\tau_{NO_2}}{\tau_{part} + \tau_{NO_2}} \left[1 - \exp\left(-\tau_{part} - \tau_{NO_2}\right)\right] \left[\exp\left(-0.78 \frac{x}{r_{vo}}\right)\right]$$

$$C_1 = \frac{-2.17 \times 10^{-2}}{5.36 \times 10^{-2} + 2.17 \times 10^{-2}} \left[1 - \exp -(5.36 \times 10^{-2} + 2.17 \times 10^{-2})\right] \left[\exp\left(-0.78 \frac{75}{25}\right)\right]$$

$$C_1 = -2.01 \times 10^{-3}$$

C_2 = Plume Contrast / Terrain

$$C_2 = \left[1 - \left(\frac{1}{C_1 + 1}\right) \exp\left(-\left[\tau_{part} + \tau_{NO_2}\right]\right)\right]\left[\exp\left(-1.56 \frac{x}{r_{vo}}\right)\right]$$
$$C_2 = \left[1 - \left(\frac{1}{2.01 \times 10^{-3} + 1}\right) \exp\left(-\left(5.36 \times 10^{-2} + 2.17 \times 10^{-2}\right)\right)\right]\left[\exp -1.56 \frac{75}{25}\right]$$

$$C_2 = -1.74 \times 10^{-5}$$

C_3 = Change in Sky/Terrain Contrast / Aerosol

$$C_3 = 0.368\left[1 - \exp\left(-\tau_{ar}\right)\right]$$
$$C_3 = 0.368\left[1 - \exp -1.98 \times 10^{-3}\right]$$

$$C_3 = 7.28 \times 10^{-4}$$

HDR

Project: Pinellas RRF — Computed: ER
Subject: Visibility Analysis — Date: 2/28/83 Sht. 3 Of 3

Note:

Since the absolute values of C_1, C_2, & C_3 are all less than 0.01 it is unlikely that the RRF will cause a visibility impairment in the Class I area.