STRUCTURE 5A

This structure is a six unit pumping plant located on the south side of U.S. Highway 441 and Canal 51 (West Palm Beach Canal) between the canal and the borrow canals of Levees 7 and 40 about 20 miles west of West Palm Beach and consists of a reinforced concrete structure with concrete superstructure. The pumping station is equipped with six Fairbanks Morse 116-inch Figure 6320 horizontal propeller pumps each rated at 800 c.f.s. at 11.1 foot static head. Each unit is driven by a Fairbanks Morse Model 38D8-1/8-1600 horsepower, 10-cylinder, opposed piston engine connected to the pump through a 2-stage 18-inch Morse "Hy-Vo" silent chain transmission. Priming of the main pumps is normally accomplished by an electric motor-driven Nash Model K-6 vacuum pump with a Diesel-driven unit for emergency operation. Semi-automatic flap valves with hydraulic restraining mechanisms are provided at each pump discharge to assist in priming and to prevent possible backflow. On the intake side of the structure, located at the trash racks, is a 6-foot electrically operated trash rake manufactured by S. Morgan Smith Co. Power is supplied for station lighting and auxiliary equipment by three Fairbanks Morse Model 31A6-1/2 100 KW Diesel-electric generator sets. A 15-ton Conco Type CR manually-operated overhead bridge crane is provided for general service and maintenance. Other station equipment includes a station service system to provide water for washdown, a dewatering system to facilitate pump servicing or inspection, and a filtered water system to furnish water for engine jacket water make-up and domestic purposes.

PURPOSE

The primary purpose of the pumping station is to pump surplus water from the L-10, L-12 basin, the S-5A agricultural area northwesterly of the pumping station into Conservation Area No. 1, at the rate of 3/4 inch per day, from the 230 sq. mile tributary drainage area.

The station has two additional functions, when these will not interfere with its primary purpose.

This station is also employed to remove excess flows from the L-8 and C-51 basins.

Finally, it is employed to remove excess water from Lake Okeechobee when it is above its regulation schedule.

OPERATION

The optimum water level in the West Palm Beach Canal within the agricultural area northwesterly of the pumping station was originally 12.5 feet above mean sea level, but this stage cannot be maintained safely because stages of about 13.0 in the Cross Canal, west of S-5A, begin to overtop low private levees.

A stage of 12.5 throughout the L-10, L-12 basin is also too close to the maximum water level to permit operational flexibility. Consequently, optimum stages of 11.5 and 10.5 are maintained during irrigation and drainage phases, respectively. These phases are defined subsequently.

The operation of the station to accomplish its primary purpose is a complex function of many variables. Each of these will be discussed separately but, of course, in practice they are considered as a group.

Surplus water enters the L-10, L-12 basin primarily by pumped discharge, and secondarily by gravity discharge from adjacent lands. The total installed capacity of the pumps discharging into the system exceeds the capacity of S-5A. This fact is a major impact of the station operation, especially if a major storm appears imminent.

1. **RAINFALL** - Rainfall is the cause of all station operation. Its intensity, distribution and duration all are significant factors. These may be considered in the following headings:

   The Current rainfall is determined by remote, digital rain gauges throughout the basin, by information from the District's Meteorologist, from the weather radar system in the Control Center and by direct observations of pump station personnel. The intensity and distribution have direct influences on the current and projected discharges into the basin from the adjacent lands, and hence on the need for station operation.

   Antecedent rainfall, which covers about the preceding 24-hour period, influences current and future discharge into the system because it controls soil moisture conditions (in parts of the basin) and hence the need and timing of the secondary system to discharge in L-10, L-12. Antecedent rainfall data are obtained in the same ways as current data.

Predicted rainfall is important in station operation in the same ways as other types of rainfall. Such information is obtained from District's meteorological forecasts and from time-lapse weather radar displays, which indicate speed, intensity and direction of rain cell movement.

2. **Irrigation/Drainage Phase** - The irrigation/drainage phase is a special designation which indicates if the dominant agricultural activity is irrigation or drainage. During the irrigation phase, stages in L-10, L-12 are held higher; during the drainage phase an attempt is made to hold them lower. The irrigation phase generally occurs in the winter and the drainage phase generally occurs in the summer. Brief periods of very wet or very dry weather at any time of year can initiate a change from one phase to the other.
3. **Time of Day** - Pumping is most apt to be initiated between 0800 and 1000, less apt between 1000 and 1600 and least apt between 1600 and 0800 the next morning, all other things being equal. This bias toward the morning hours relates to scheduling of pump station personnel.
4. **Time of Week** - In a similar way, pumping is most apt to be performed on Fridays, or other days before holidays, less apt to be performed on other week days and least apt on weekends and holidays, other things being equal. This bias is also related to scheduling of pump station personnel.
5. **Notifications** - An early warning agreement exists between the District and all major interests which pump into the L-10, L-12 basin. Each of these interests has agreed to notify the District of the time and projected quantities of their intended discharge into L-10 and L-12.
6. **Water Levels** - in the primary basin, L-10, L-12, water levels are monitored continuously by District C & C System: At S-5A - headwater, at S-5AY (at Big Mound), at S-5AX tailwater, at S-352 (land side). The actual water level and the rate of change are of significance. Though the significance of water levels must be related to the other factors, there are certain absolute values which, when approached, must be weighted disproportionately with respect to the other factors. If the tailwater at S-5AX exceeds

13.0 overtopping of levees occurs on the Cross Canal. The following table indicates the design and maximum historic flows and stages in the L-10, L-12 basin:

		CANAL POINT	BIG MOUND	S-5A
Design				
Discharge	(cfs)	-	2,400	4,600
Stage	(ft)	13.7	12.6	8.3
Historic	(3/70)			
Discharge	(cfs)	-	1,500	5,300
Stage	(ft)	14.8	14.2	12.5
Secondary Discharge Capacity (cfs)				
1973		-	3,700	7,900
Fully Developed		-	3,700	10,000

The above discharges and stages serve as a frame of reference. The canal has been improved over the years. In practice, stages at any of the three locations in excess of 12.0 or a rise in stage of 0.5 feet per hour would be viewed with alarm and a cause to initiate pumping, in the absence of a change in District pumping or hurricane gate operations.

Water levels in adjacent basins are sometimes of importance to the operation of the S-5A pumping station. When inflows from these basins will not jeopardize flood control in the L-10, L-12 basin, the appropriate gates are opened and S-5A is placed in operation.

The pumps shall be started slowly, one pump at a time, so that high velocities and surges will not occur in the West Palm Beach Canal. The operation Chart defines the entire recommended range over which pumping can be accomplished. Inasmuch as the reduction ratio between engine and pump is fixed, all pump rotative speeds are expressed in the engine speed which is indicated on the engine tachometer. The rated speed is 714 r.p.m. At this speed, the pumps will pump 800 c.f.s., or greater, within the following ranges of head, provided both conditions are not exceeded.

A. When intake pool gauge reads 8.3 m.s.l. or higher

B. When the pool discharge gauge reads 19.4 feet or lower.

The pumps are also designed to operate with the water drawn down in the intake bay to a

minimum reading of 6.3 feet on the intake bay gauge. Satisfactory operation under this condition can be obtained under all ranges of head up to a reading of 17.4 on the discharge pool gauge. Should pumping be required during times when the intake bay is drawn down to 6.3 and the discharge pool gauge exceeds 17.4 feet, the rotative speed should be reduced to less than 600 r.p.m.

No pumping should be conducted with the water surface in the intake bay below a gauge reading of 6.3 feet because under this extreme suction lift condition pitting of the propellers is likely to occur. If, during a pumping operation, the water surface be drawn down below 6.3 on the intake bay gauge, the speed of all pumps then operating should be reduced to less than 600 r.p.m. If this does not restore the water surface in the intake pool to elevation 8.3, one or more of the pumping units should be shut down until the minimum pool elevation is re-established.

The pumps in this station are designed to pump drainage water containing a negligible amount of sediment or other material which might damage the surfaces of the pump or the bearings. All pump bearings are designed for grease lubrication and to exclude dirt and grit. However, the quantity of water being pumped by the station should be reduced at any time the water in the suction bay becomes moderately silted or if it appears that the approach velocities are carrying a bottom load of sand or silt into the sump chambers.

The pumps installed in this pumping station have a tenth order critical at 382 engine r.p.m. and a seventh order critical at 546 engine r.p.m. Therefore, the pumps should not be operated with a range of 345 to 420 r.p.m. and 490 to 600 r.p.m. as indicated on the engine tachometer. All operations through these speed zones either accelerating or decelerating should be made as quickly as possible.

FLOOD DISCHARGE CHARACTERISTICS

Discharge Rate	4600 c.f.s.
Headwater Elevation	13.0 feet
Tailwater Elevation	24.1 feet

DESCRIPTION OF STRUCTURE

Type 6 pumping units in a reinforced concrete and concrete block structure.

Number of Pumps: 6

Size and Type of Pumps: 116 inch horizontal propeller

Design Rating: 800 c.f.s. each

Impeller Speed: 125 r.p.m.

Pump Manufacturer: Fairbanks Morse

Engine Make & Type: Fairbanks Morse 10-cylinder, opposed cylinder diesel

Engine Horsepower: 1600 each

Engine Speed: 714 r.p.m.

Gates (per bay)

Number: 2

Location: downstream end of discharge tube

Type: multiple shutter flap valve

Size: 12.0 feet high by 13.0 feet wide clear

Lifting Mechanism: flaps opened by hydraulic cylinder and chains lifts over pulley.

Date of Transfer: May 2, 1955; S-5A building addition August 27, 1956

DEWATERING FACILITIES (per bay)

Storage: On-site

Type: bulkhead gates

Size and Number:

Number: 6

Length: 27' -1"

Height: 5' -0"

Width: 1' -9"

POWER SOURCE

Prime Movers: Diesel engine

Station Power:

Normal: commercial electricity

Emergency: Diesel engine driven electric generator

HYDRAULIC AND HYDROLOGIC MEASUREMENTS

Water Level: On-site, dual analog recorder. On-site (U.S.G.S.) headwater, tailwater, digital recorders. Remote, digital headwater and tailwater recorders.

Gate Position: None

Rainfall: Remote, digital recorders and on-site analog recorders

Engine Tachometers: Digital, on-site and remote

Wind Speed and direction: Remote

NOTE: Other instrumentation at S-5AS, S-5AE and S-5AW.