CHAPTER 10W. - SUPPLY TREATMENT AND COLOR REMOVAL

The scope of this chapter is to describe, evaluate the existing treatment system, and make recommendations for improving the system. This chapter deals with the processes involved, the mechanical equipment, controls, and maintenance of the existing and proposed treatment facilities.

Description of the Existing Raw Water Pumping System

The raw water that enters the treatment plant enters into a sub-grade concrete raw water well. The storage volume of the well is approximately 4600 gallons depending on the water level in the river, and the volume of accumulation of sand and rocks in the bottom of the well.

There are four vertical turbine pumps, located above the raw well, which pump raw water from the well through the treatment plant, i.e., into the upflow clarifier which flows into filters and into the clear well below the filters.

Evaluation of the Raw Water Pumping System

The pumping capacity of 3 of the raw water pumps is 250 g.p.m., and the fourth pump has a 500 g.p.m. capacity. However, these pumps are not metered, and no pressure gages exist to evaluate the pumping capacity or state of condition of any of the pumps. Our field testing revealed the following capacities of the raw pumps.

Raw Pump No.	H.P. Design Capacity (g.p.m.)	Actual Capacity (g.p.m.)
Raw Pump 1	250	170
Raw Pump 2	500	380
Raw Pump 3	250	not operable
Raw Pump 4	250	190

The total pumping capacity should be 1250 g.p.m., but was found to be 740 g.p.m., which is actually the maximum treating capacity of the water plant. The raw pumps are shown in Fig. 10W.-10.

The electrical controls for the raw water pumps are not reliable. When the clear well has water in it, they pump. When the raw well is empty they shut off. The cause of the problem in Fig. 10W.-3 is the result of the raw pumps pumping even though the clear well is full, and hence the clear well overflows out the doors until the pumps are manually turned off or the raw well empties, and they automatically shut off. This flooding not only creates an inconvenince for the operator, it also creates a serious health hazard by contamination of the water in the clear well.

In addition, these four raw water pumps are in very poor mechanical condition due to little or no maintenance, and the pumps being continuously subjected to sand, rocks, etc. Consequently these pumps never function for their intended design periods, and must be replaced, frequently. The pump motors do not appear to be damaged.

Description of Existing Coagulation - Flocculation - Sedimentation System

The clarification operation is critical in the production of good quality water. As discussed in Chapter 6W., the coagulation and flocculation process not only clarifies the water, it also can help in bacteria removal. The raw water pumps pump water upward through the existing clarifier and the water runs over an overflow weir plate, onto the two sand filters.

The clarifier is a large funnel shaped structure, which contains a small mixer and large paddle blade. The motors for the mixer and paddle are mounted above the clarifier. 3 dry chemical feeders are located near the mixer. The feeders mechanically add dry chemical coagulants to a water basin where they are mixed into solution and then added into the clarifier for coagulating and flocculating turbidity, etc.

The theory of this particular upflow clarifier system is that as the impurities are mixed with the coagulant, they will flocculate and become too heavy to be carried upward through the clarifier. As these flocculate and settle downward, the floc will also "knock down" or carry with it other small impurities that are moving upward through the clarifier where the paddle blade pushes it toward the center of the clarifier. When the floc sediment builds up in the bottom of the clarifier, the clarifier is drained and the sediment carried away into the discharge shown in Fig. 10W-1 and 10W-2.

Evaluation of the Existing Coagulation-Flocculation-Sedimentation System

As discussed in Chapter 6W., there are many important factors involved in a successful coagulation-flocculation process. Many requirements must be met for the process to be efficient.

The most important requirement is that the proper coagulant dosage must be routinely determined through jar testing, and then the feeders adjusted to supply this dosage. The mixing speed determined in the jar test should be used to set speed on the clarifier mixer. The detention time determined by the jar test can be set by varying the valves on the raw water pumps to increase or decrease the flow rate through the clarifier, and allow a low enough overflow rate to allow sedimentation to occur without carrying the floc over the weir onto the filters.

As indicated above, this process requires a skilled operator, who is diligent enough to run the plant and vary the processes as the water quality and treatment required varies. Unless a competent operator is in the plant on a full time basis, these requirements cannot be determined and fulfilled, and consequently the water treatment process cannot be maintained at a maximum level of efficiency.

Evaluation of the physical parts of this process is rather simple. A generally agreed upon overflow rate for clarification is about 14-15 g.p.m./ft. of weir length. The present weir is about 50 ft. long. The maximum overflow rate using this figure is about 700-750 g.p.m. or 1 M.G.D. However, the raw pumps that fill this clarifier are capable of pumping 1250 g.p.m. through the clarifier. This high rate will cause floc to carry over to the filters and result in shorter filter runs by quickly plugging them. There is no meter to measure the flow through the clarifier so it is not known what volume is going through the clarifier.

The three chemical feeders are not capable of running automatically or adequately proportioning the chemicals as required. They all leak, are not operable most of the time, and in general are inadequate for the majority of the time. They have not been maintained or taken care of.

The motors on the clarifier mixer operate but the mixing speed cannot be adjusted. One motor needs repair, but the standby motor is operating.

The 4 inch drain on the clarifier plugs easily, and thus the clarifier is not routinely drained. However, since the process is not efficient, sediment only rarely builds up to require frequent flushing.

As a result of inefficient operation of the clarification system, the water is often times not clarified as it should be, and many bacteria normally removed by coagulation are passing through the clarifier, through the filters and into the clear well.

Description of the Existing Filtration System

The existing plant contains two rapid sand filters. The water from the clarifier flows into an influent pipe to each filter, and flows over two distribution troughs onto each filter bed as shown in Fig. 8W.-2. The filter bed depth is approximately 40 inches.

The water filters through the filter sand, through the undrain gravel and block system which supports the sand, through a filter effluent valve and into the clear well . The filter effluent valve is designed to open on water demand or when the raw pumps turn on, and close when the filters are not filtering water, thus keeping water in the filter at all times.

A backwash pump shown in Fig. 10W.-6 is provided to pump filtered water back up through the filter sand and clean the filter periodically. The residue and impurities are flushed out of the sand and carry over into the distribution trough where they are flushed out into the discharge ditch shown in Fig. 10W.-1

The filter system was originally designed to have a pneumatic/hydraulic indication and control system to aid the operator in determining flow rates and loss of head through the filters and indicate to him the efficiency of the process. Fig. 10W.-7,8&17 shows the state of this system. All other indications from local residents indicate some parts of this system were never installed or made operable by the Contractor when the plant was constructed in 1957.

Evaluation of the Existing Filtration System

Evaluation of the system involves three major areas which affect the efficient operation of the filters, the media and under-drain system, the filter effluent valve, and the backwash system. The combination of the three have led to serious problems for the operator and caused decreased treatment efficiency for years.

The filter bed should be submerged under water at all times. Many times the filters drain dry, which is often the case whenever the raw pumps are not pumping. The cause of this is the leaky filter effluent valve.

The filter effluent valve is designed to close automatically when the filter cycle is over, and open when demand is exerted on the system. However, this valve has been inoperable or leaked for at least one and a half years. Thus, the valve has not been closed, or maintained the filter beds in a submerged state, and the filters are allowed to dry out until the raw pumps come on again. The results of the valve not closing are listed below:

1. The filters dry and develop cracks along the walls and other areas. When raw pumps come on, the water short cuts through these cracks directly into the clear well without being filtered. These break throughs are undesirable, as turbidity gets through, and sand can escape the filter into the clear well.

2. When the filters dry, they draw air down into the sand and under drain system. When water comes back onto the filter the air is trapped in the filter bed. When the backwash water is run up through the filter, this trapped air is

rapidly blown out and leaves large voids in the under drain gravel and filter sand. Again, these voids are areas where turbidity, floc, sand or any other filterable material can break through into the clear well avoiding treatment.

3. The sand and impurities that escape the filters and get into the clear well are then capable of being pumped into the distribution system. This is obviously the case when time and again during the spring months sand begins to clog small lines in homes and toilets throughout the Town. Sand has been found to be 2 inches deep in some of the 4 inch diameter water lines in the lower areas of Town. This sand creates real problems for the installation and operation of meters, valves, etc. in the distribution system.

In addition, the valving on the filter piping system is leaky and not easily operable. Fig. 10W.-8 shows valve stems that are not operable. The plug valves on the backwash drain lines leak continuously, and during the winter months cause large ice buildups and a hazard behind the plant as shown in Fig. 10W.-9.

The backwash pump appears adequate. However, the pump has no meter or pressure gage to indicate operating efficiency. Conventional backwash rates vary from 15-18 g.p.m./ft.^{2} of filter bed area. This is about a 2200 g.p.m. rate and according to pump curve data, the pump is adequate for backwashing purposes.

Description of the Existing Disinfection System

The existing disinfection system is a gas chlorination system. High pressure water which comes off the high service pump manifold line, feeds water through a chlorine gas eductor located in the chlorine room. The rising velocity and consequent dropping pressure across the eductor draws chlorine gas into the eductor where it mixes with the water. The chlorine-water solution is then introduced into the raw water pump manifold, see Fig. 10W.-16, just before entering the clarifier. The chlorine has ample contact time in the clarifier and through the treatment plant, before being pumped into the system.

Evaluation of the Existing Disinfection System

The existing disinfection system is completely outdated in terms of todays health and safety standards although it appears to adequately accomplish its purpose. The system should not be located on the second level of the plant, as chlorine gas is heavier than air and will accumulate downstairs at the entrance of the plant. The gas masks are located downstairs at the plant entrance. A serious health hazard exists should an undetected leak develop in the system.

The chlorine room should be provided with an exhaust fan that comes on when the chlorine door is opened. The existing fan does not operate, so the windows are left open. In addition, a light switch should be located outside the room. There is no operable heater in the room, and ice has been seen building up on the leaky water pipes in the chlorine room during the winter.

There is no way to tell if chlorine leaks exist, other than the Operators sense of smell. A bottle of ammonium hydroxide, which when mixed with chlorine gas turns to a visible smoke, should be placed in the chlorine room and another be available to the operator downstairs to warn of chlorine leaks.

Description of the Existing High Service Pumping System

There are 3 vertical turbine pumps as shown in Fig. 10W.-10, which pump the treated water from an 80,000 gallon clear well to the distribution system and to storage. Each of these pumps are rated at 250 g.p.m. at 220 feet (95 p.s.i.) T.D.H. Their combined capacity is 750 g.p.m., the approximate filtering capacity of the plant. The treated water is pumped from the clear well through a 10 inch diameter Sparling meter tube into the system. See pump curve data in Appendix.

Evaluation of the Existing High Service Pumping System

The three high service pumps have been evaluated. The 10 inch diameter meter leaks badly, and has undoubtedly suffered some sand damage. A pressure gage does exist on the manifold leaving the pumps so that the pump efficiency can be determined. The following data was collected on the high service pumps.

PUMP NO.	DESIGN CAPACITY G.P.M.	FIELD CAPACITY G.P.M.
1 (east)	250 @ 220'	210 g.p.m. @ 85 p.s.i.
1 (center)	250 @ 220'	240 g.p.m. @ 85 p.s.i.
1 (west)	250 @ 220'	190 g.p.m. @ 85 p.s.i.

The pumps have been replaced frequently in the past due to damage caused from pumping sand which leaks into the clear well as previously discussed. They have not been properly maintained and are in need of repair.

The controls and power to the pumps are faulty as they often blow fuses or will not come on, when signalled.

Description of the Existing Clear Well

The existing clear well is an underground concrete structure which has a storage capacity of 80,000 gallons. The purpose of the clear well is to provide for an adequate volume of reserve water that can be pumped into the system and to provide adequate contact time for chlorine disinfection processes.

Evaluation of the Existing Clear Well

The existing clear well is structurally sound. However, it has hairline cracks and some leakage. When the high service pumps are on, and water is being drawn down in the clear well, air suction can be heard and felt around the upper portions of the concrete. These same areas also seap out water when the clear well overflows. It is evident therefore that cracks exist in the upper areas of the concrete and more cracks and leaks may exist as well below ground.

Description of the Existing Control System

The existing water treatment plant is powered by 240 V. alternating current supplied to the plant by Carbon Power & Light Co. The controls and electrical wiring in the existing plant are designed to run the plant with 1957 technology. The control system is vital to monitoring and operation of the plant.

The entire system now is operated by water level sensing devices in the elevated tank. A dropping water level signals the high service pump(s) to start refilling the tank. When the tank is filled, the high service pumps shut off.

The raw pumps are controlled in part by water levels in the raw well and whether or not the tank is full. If the tank level is dropping a signal is relayed to the raw pumps to allow them to pump, but only if the raw water well has ample water in it. If there is not ample water in the raw well, then the signal from the tank is overriden. If there is ample water in the raw water well, then the raw pumps will come on, and continue to pump.

Monitoring of the system was designed into the plant. A Bristol Circular tank level chart recorder was designed to record tank levels on a continuous basis.

Monitoring of the pressure losses through the two sand filters was also part of the original design. The pressure loss through the filter increases as it filters out more impurities. The monitoring gages were intended to show the state of those filters, and give the operator an indication of the amount of plugging of the filters and thus indicate when to backwash them.

In addition to the control system power supply, Carbon Power and Light has furnished a 240 V. A.C. fuel powered generator. The Power output of the generator is 50 killowatts. The generator is used when there are power outages, and has adequately run the plant in the past.

Evaluation of the Existing Controls System

Figure 10W.-13 shows the majority of the electrical wiring and controls for the plant. These controls, and wiring system are as old and outdated as the plant itself, although in general they still perform.

There are several serious problems with the existing electrical and control system, that need immediate improvement. These are listed below:

1. The telemetry system that relays the water level signal information is not dependable in operating the high service pumps or the tank level recording chart.

2. The tank level recording chart has not been maintained and is inoperable.

3. Raw water pumping controls are inadequate and consequently the pumps overflow the clear well occasionally.

4. The pumps frequently blow fuses, and then remain inoperable until the fuses are replaced.

5. The "automatic" filter effluent valve is old, outdated, and inoperable, see Fig. 10W.-14.

6. The water flow through the meter on the filtered water line should be continuously recorded, but isn't, since that recorder is also inoperable.

7. The monitoring system for pressure loss through the sand filters does not function. These apparently were never completed under the original construction contract in 1957, and hence have never worked.

8. The standby power generator is not immediately operable since the battery to start it is missing. The generator is seldom maintained, or routinely switched over to run the plant as should be the case. Therefore, the generator is not ready in case of emergency, and is worthless unless maintained. Its power output capacity is limited to 240 volt power.

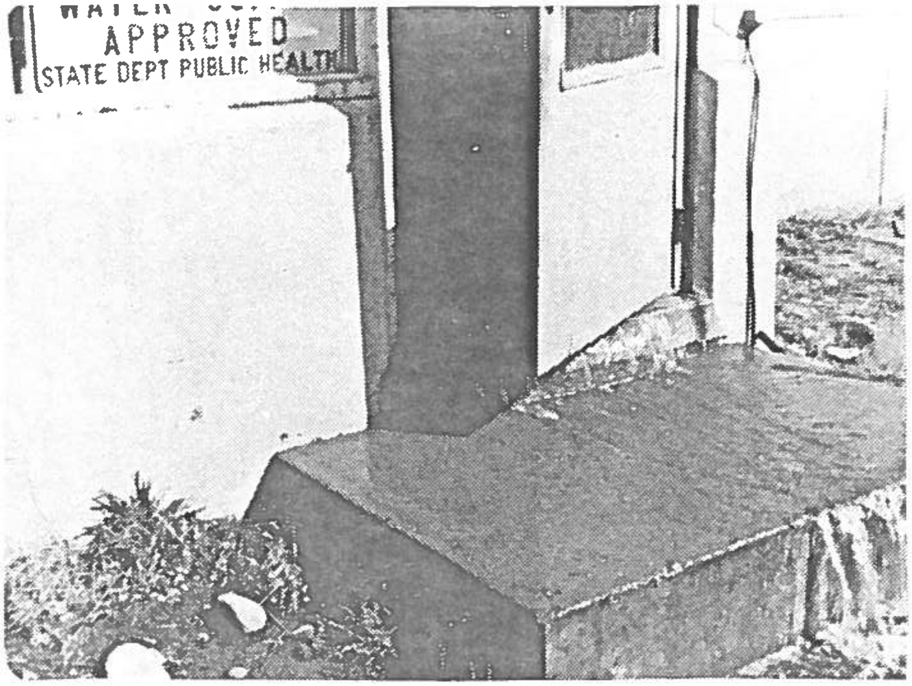


Fig. 10W-1

Discharge Ditch From Existing Water Treatment Plant to River

Fig. 10W-2

Clarifier Manhole Drain Pit with Lid off, Subject to Freezing

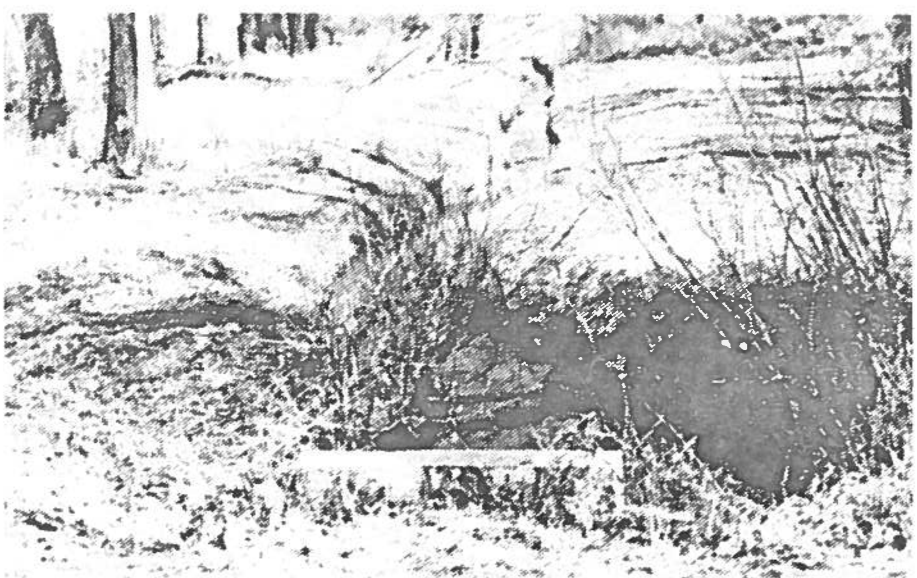


Fig. 10W-3

Filtered Water Flowing Out of Clearwell in Existing Plant, a Frequent Occurrence

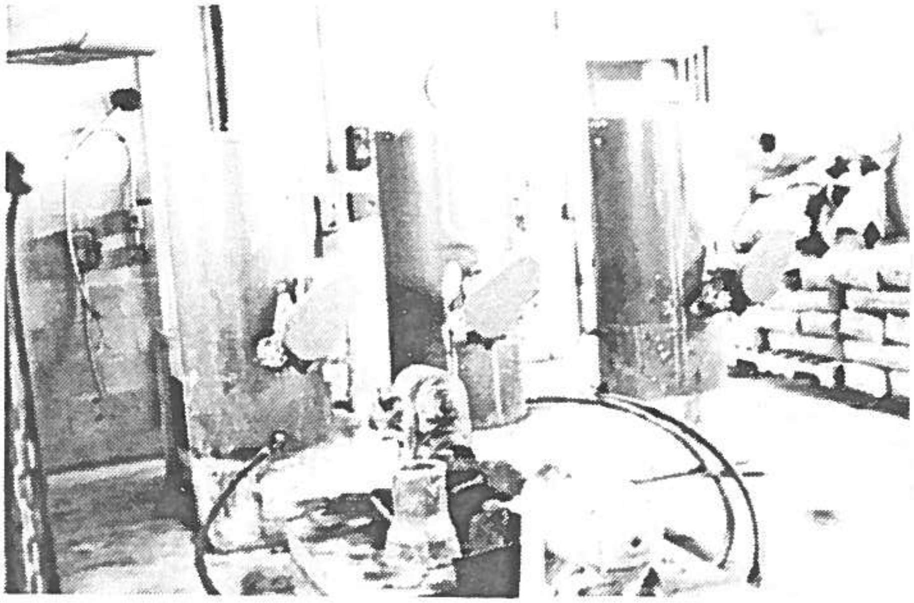


Fig. 10W-4

Dry Chemical Feeders, Existing Water Treatment Plant

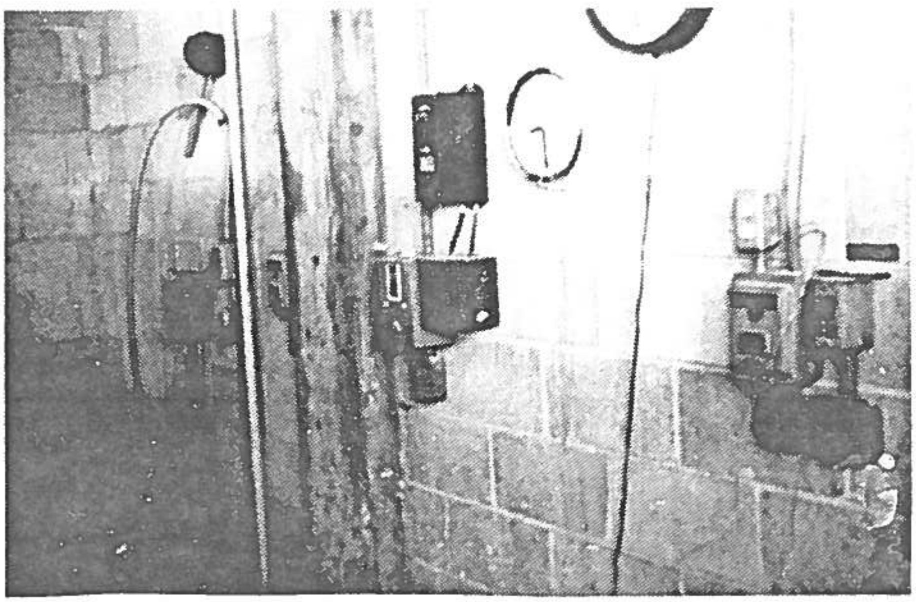


Fig. 10W-5

Manual Controls for Each Chemical Feeder in Existing Water Treatment Plant

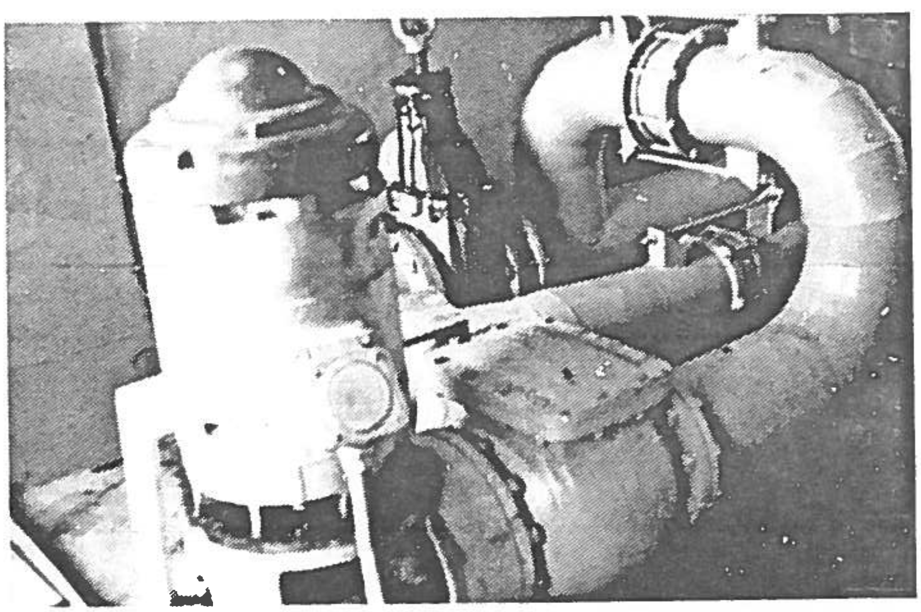


Fig. 10W-6

Backwash Pump, Existing Water Treatment Plant

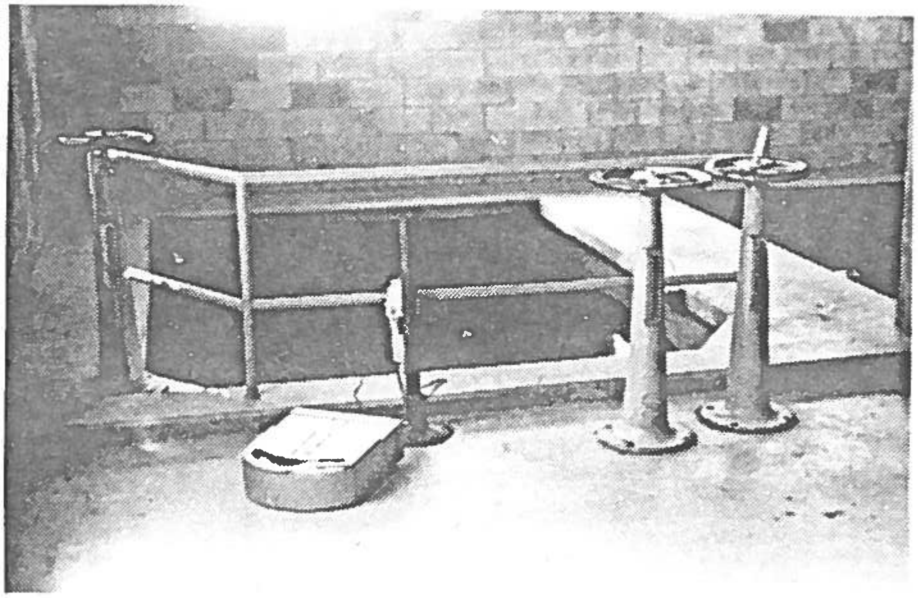


Fig. 10W-7

Valve Pedestals and Pressure Indicating Device on East Filter in Existing Water Treatment Plant, Not Operable-1977

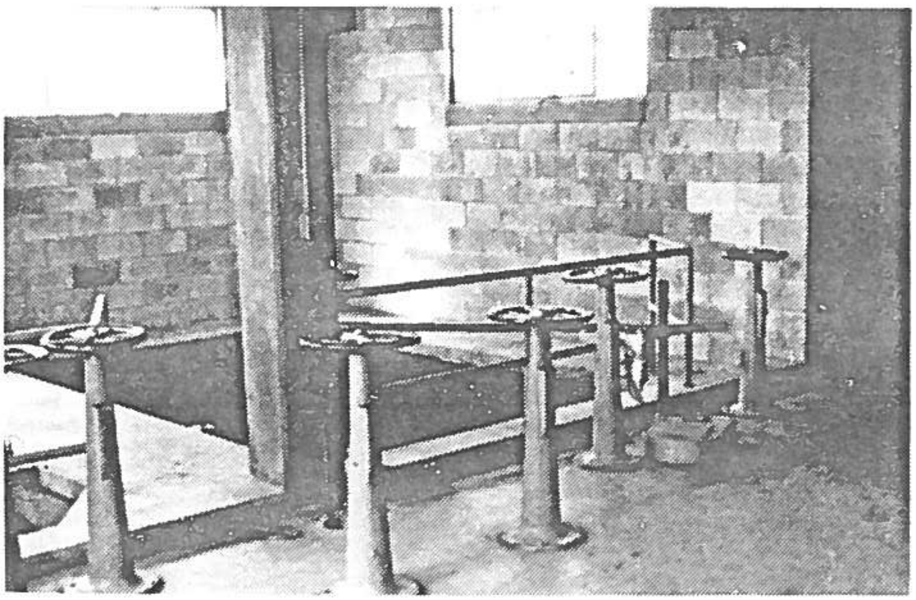


Fig. 10W-8

Valve Pedestals and Pressure Indicating Device on West Filter, Not Operable in Existing Water Treatment Plant

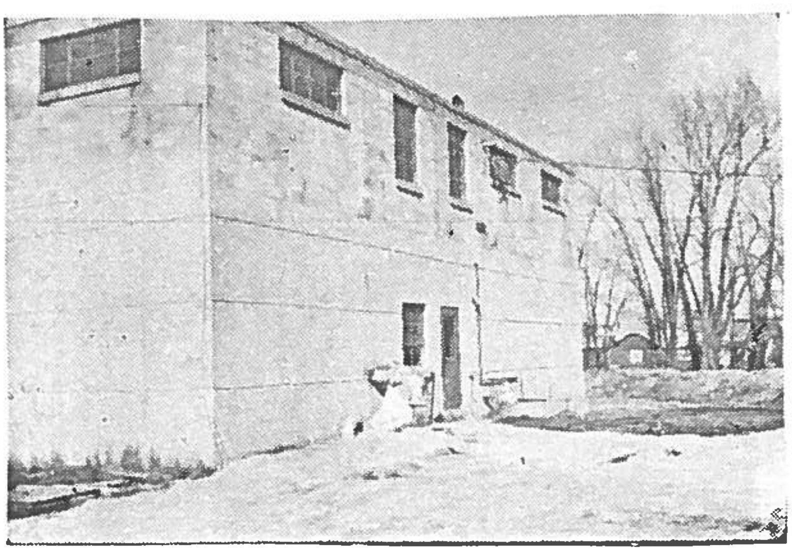


Fig. 10W-9

Ice Build-up Behind Existing Water Treatment Plant Due to Leaky Sand Filter Drain Valves

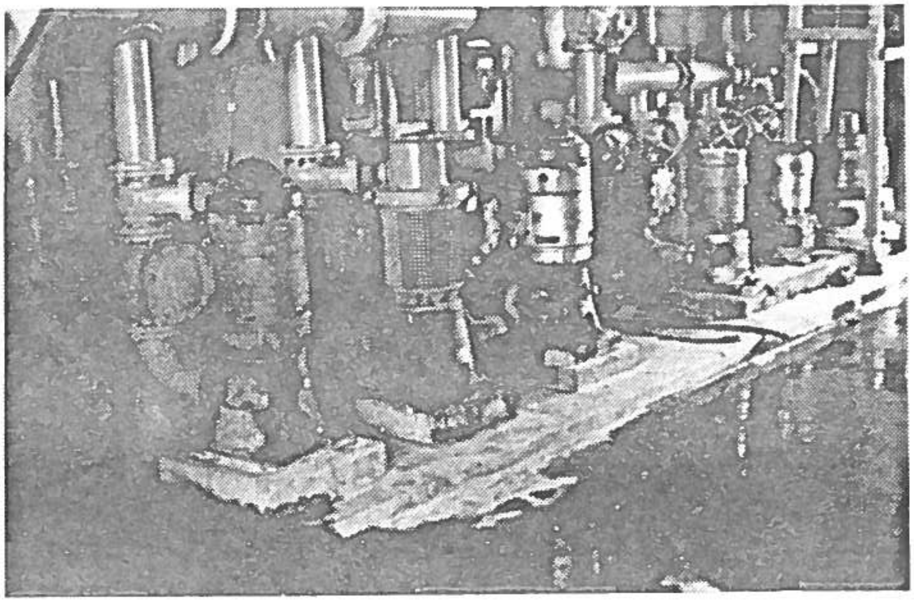


Fig. 10W-10

3 High Service Pumps on Left and 4 Raw Water Pumps on Right in Existing Water Treatment Plant.

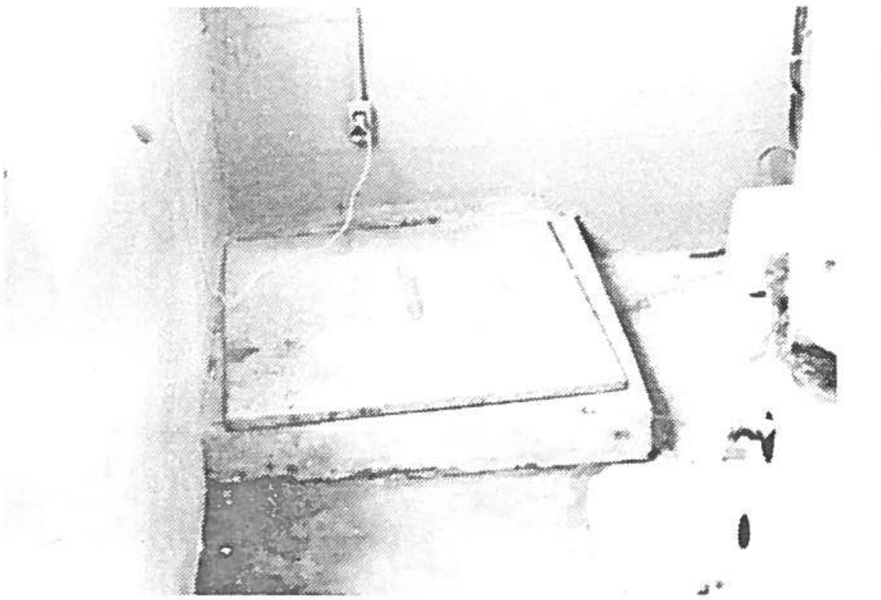


Fig. 10W-11

Clearwell Access Hatch is a Metal Lid, Not Water Tight and is Subject to Contamination in Existing Water Treatment Plant

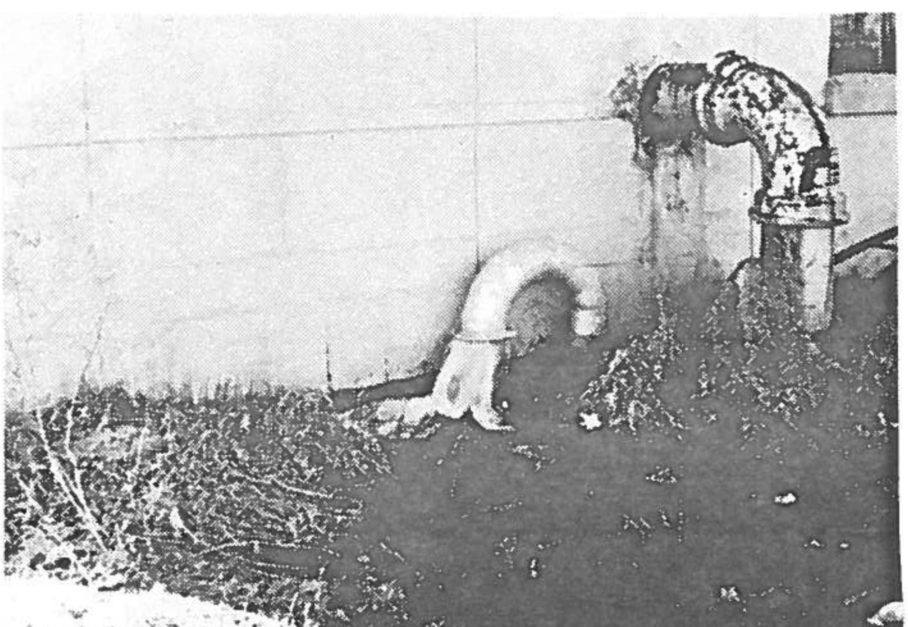


Fig. 10W-12

Clearwell Overflow/Vent Lines Overflowing at Existing Water Treatment Plant

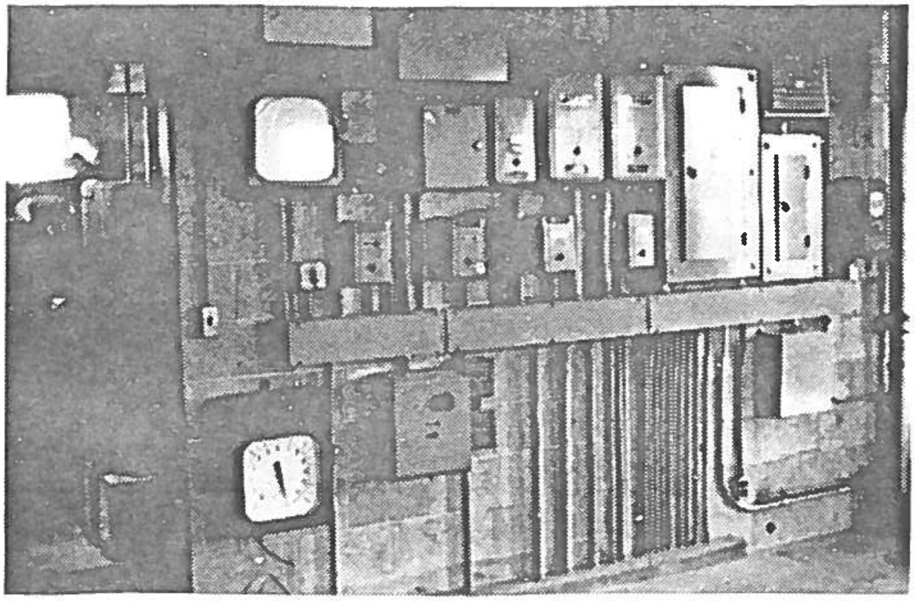


Fig. 10W-13

Existing Water Treatment Plant Electrical Wiring and Controls Center

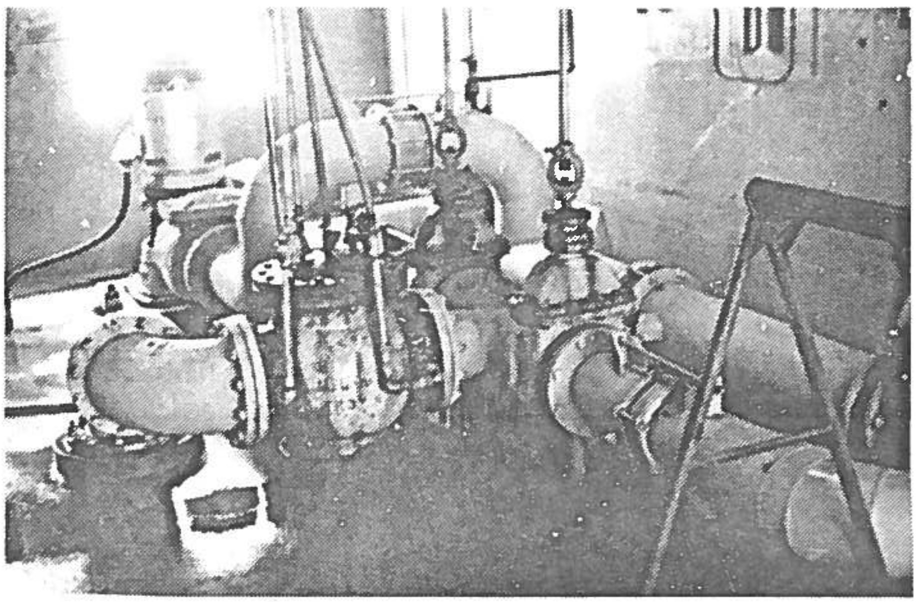


Fig. 10W-14

Automatic Filter Effluent Valve, "The Ross Valve"

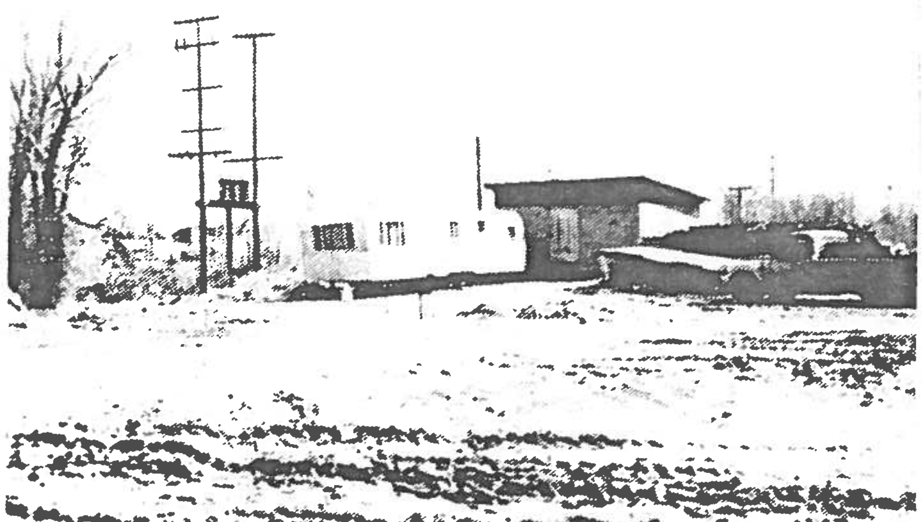


Fig. 10W-15

Standby Power Generator in Block Building Behind Trailer, Existing Water Treatment Plant

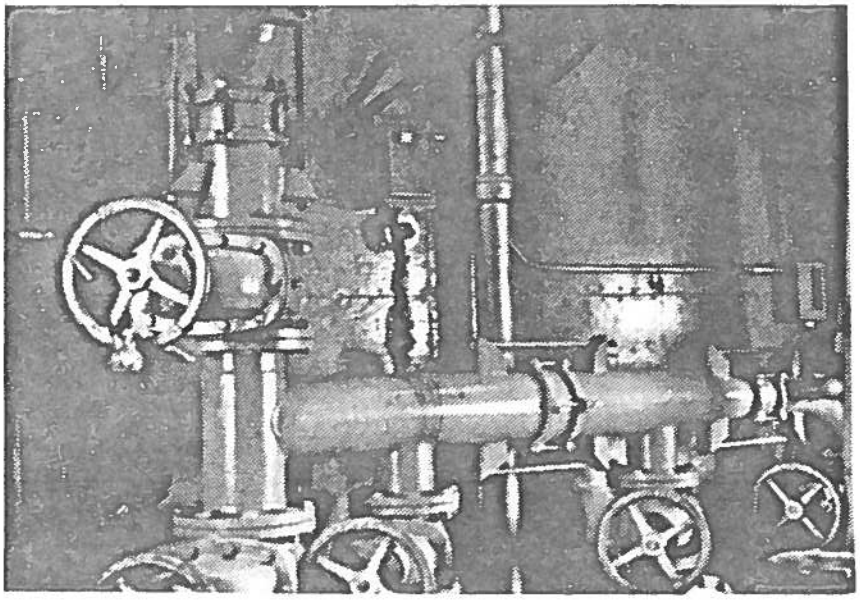


Fig. 10W-16

Chlorine-Water Solution Introduced into Raw Water Pump Manifold, Existing Water Treatment Plant

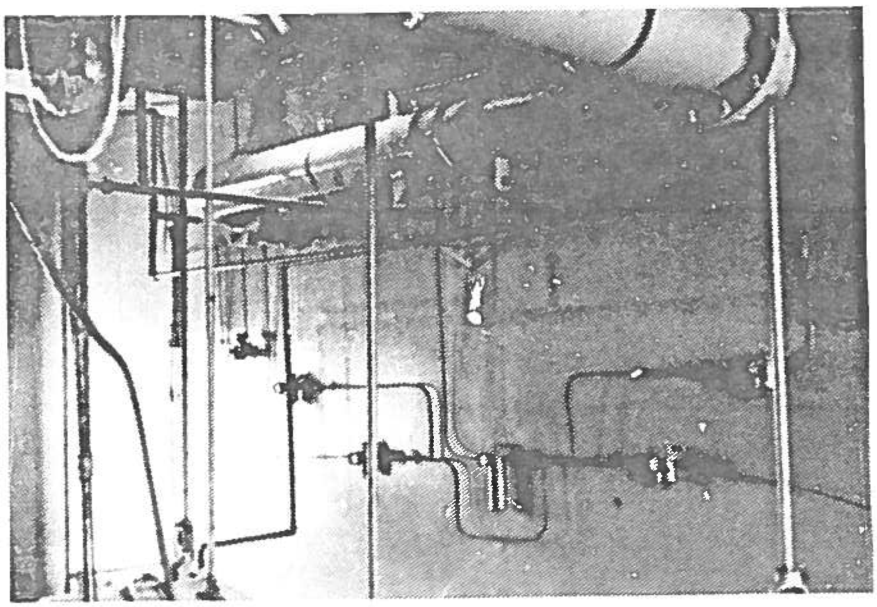


Fig. 10W-17

Non Functional Pneumatic/ Hydraulic Filter Controls System in Existing Water Treatment Plant

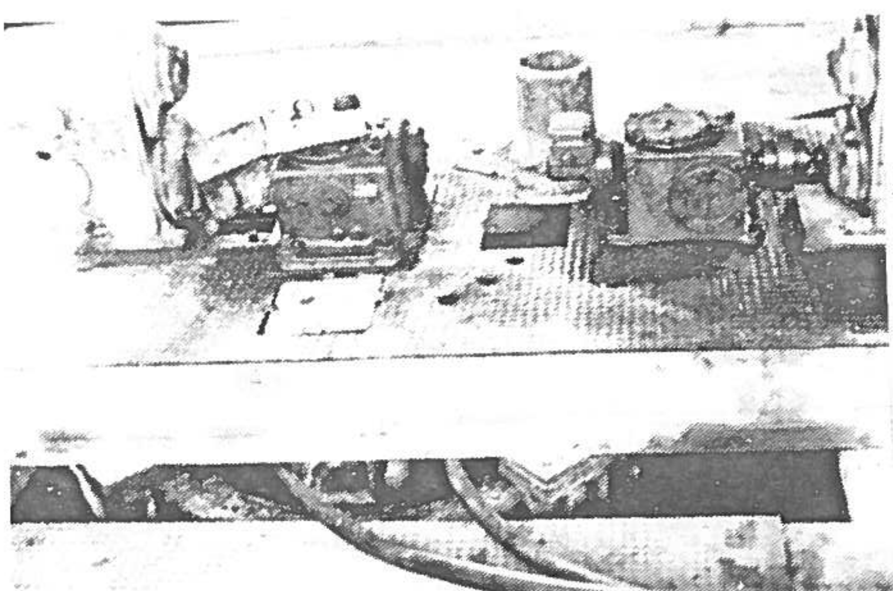


Fig. 10W-18

Clarifier Mixer Motor and Paddle Drive Motor in Existing Water Treatment Plant

CHAPTER 11W. - TREATMENT SOLUTIONS

The scope of this Chapter is to present the Five Water Treatment Options presented to the Joint Powers Board for their review in the Spring of 1977. It should be pointed out that due to the serious shortages of water and the curtailment of building permits the Board decided to delay the writing of this report and requested us to design for immediate construction a water treatment facility and other improvements that would remedy their problems by Spring of 1978. This request put a serious handicap on the design since it allowed no time to perform any pilot plant testing or gather other experimental design data that would justify our recommendations. Following our final recommendation, the Board did accompany us on a trip to Estes Park and Golden, Colorado to view and familiarize themselves with the type of equipment and processes involved in the final recommendation that we had made. With this in mind, the five alternate treatment options will be presented here, with emphasis being placed on the treatment option that we recommended and the Board approved. The options and costs are summarized in Table 11W.-1.

TABLE 11W. - 1

COST SUMMARY - SARATOGA WATER TREATMENT

OPTION	FLOW GPM	DESCRIPTION	CONSTRUCTION COST
1	1400	MIXED MEDIA FILTRATION & PLANT RENOVATION	$ 450,000
2	2400	OZONATION, CLARIFICATION	475,000
3	2400	D.E. FILTRATION WITH ACTIVATED CARBON	750 000
4	2400	OZONATION, D.E. FILTRATION	850,000
5	1000	ADD COAGULATION-FILTRATION to 1 ABOVE (450,000 + 850,000)	= 1,300,000
5A	1000	ADD D.E. FILTRATION W/ACTIVATED CARBON to 1 ABOVE (450,000 + 600,000)	= 1,050 000

DISCUSSION:

Option # 1 would remove color by coagulation-filtration but is 1000 gpm short of options 2, 3, and 4.

Option # 2 does not include any filtration for guaranteed 1 JTU or less turbidity, or backup filtration for color removal.

Option # 3 does not have ozonation but would probably remove a satisfactory amount of color.

Option # 4 has all treatment necessary for highly polished water with color removed, keeps existing clear well, and refurbishes existing plant.

Option 5A - Use renovated plant with 1000 gpm D.E. Has problem of two separate types of operations, and another structure.

RECOMMENDED CONSTRUCTION

The construction recommended to remedy the bulk of the treatment problems is covered in this Section. Five alternate solutions for improving the existing facility and/or constructing a new one were thoroughly examined and are summarized hereinafter.

Each of the following treatment options will provide an adequate solution to the problems and provide a finished water quality that in our opinion will meet or exceed the National Primary Drinking Water Regulations. All five alternates involved using the backwashable infiltration gallery for supply so this will not be reviewed here, nor the cost of construction included in the estimates.

A. Treatment Option No. 1

Fig. 11W.-1 schematically shows the proposed plan. This plan intends to use the existing water treatment plant and to thoroughly renovate it. The plant was inspected by W.E.A.I. and found to be structurally sound.

The plan includes replacement of filter underdrain systems and media, in both filters. The media to be used will be mixed media, and will give the plant a capacity of 1400 g.p.m. or 2.0 m.g.d., in essence, doubling the capacity of the existing plant. It was calculated that the existing plant is hydraulically limited to 2.0 M.G.D. without expensively increasing the piping through the plant. Renovating the existing plant includes:

1. Renovation of raw water pumping system and metering it.
2. Renovation of the chlorination system.
3. Renovation of the clarifier and replacement of the three dry chemical feeders.
4. Renovation of the sand filters and underdrain system with mixed media.
5. Patching and some cleanup of the existing 80,000 gallon clear well structure.
6. Construction of a new fluoridation system to aid in the prevention of dental caries.
7. Replace the 3 high service pumps and piping, and renovating the existing metering system to be a totalizing indicating and recording system (T.I.R.).
8. Renovate or replace the telemetering system and automatic controls system.
9. Renovate or replace the existing internal plant electrical system and controls system.
10. General patchwork and renovation of the interior and exterior of the water plant structure.

The features of this proposal are:

1. Renovation of the existing structure saves the higher costs of constructing a new facility.
2. Color removal could be expected by proper coagulation, and full time operator input.

3. The capacity of the plant would be 2 M.G.D., 1.25 M.G.D. below the recommended capacity for 5000 people, and thus would only be capable of serving 3200 people.

4. The estimated cost of construction is $450,000.

B. Treatment Option Number 2

Fig. 11W.-2 shows proposed treatment Option No. 2 that includes ozonation of the raw water in the existing clarifier, followed by residual chlorination. The plan calls for abandoning the existing filter system and by passing from the raw well through the clarifier directly into the clear well. It is felt that ozone itself offers such a complete treatment system, that the filtering process through the infiltration gallery combined with color removal through ozonation, would produce a water quality that meets the new standards. The capacity of this plan is 2400 g.p.m. or 3.25 M.G.D. since the clarifier is not hydraulically limited to the rates that the filters are.

Construction/renovation of the plan includes:

1. Renovate the existing raw water pumping system and meter it.

2. Modify the clarifier with a baffle system to provide adequate contact for ozonation. Increase and renovate the existing clarifier sludge removal piping system.

3. Purchase an ozonation system and install it in the existing filter area. Pipe the ozonator to distribute ozone into the existing clarifier.

4. Construct a fluoridation system for a capacity of 2400 g.p.m.

5. Renovate the existing chlorination system to a capactiy of 2400 g.p.m., expandable to 4500 g.p.m.

6. Replace the existing high service pumps, piping and metering system with a new system, that totalizes, indicates and records.

7. Replace or renovate the existing internal plant electrical system and controls system.

8. General patchwork and renovation of the interior and exterior of the water plant structure.

Features of this plan include:

1. Renovation and use of the existing structure saving the higher costs of new construction.

2. The plan allows for an initial capacity of 5000 people.

3. Construction of a 76 p.p.d. ozone generating system and dissolution and off gas destruction system, expandable to 150 p.p.d., will provide color removal, taste and odor reduction and enhance the esthetic quality of the water. However, the turbidity is high during high runoff periods, and the higher turbidity will interfere with the efficiency of the ozonation process as proven by our testing in Boulder. This interference will require a larger ozone generating system than would be required with a prefiltration system.

4. Full color removal and complete disinfection is expected through the ozonation application. However, should more complete turbidity removal beyond the infiltration gallery be required, i.e., for those months of May and June and high runoff, the system may not be capable of meeting the turbidity requirements set forth in the new standards. This may be avoided by maintaining

the infiltration gallery at peak operating efficiency through a diligent backwashing program during the high turbidity periods.

5. The estimated cost of construction is $475,000.

C. Treatment Option No. 3

Fig. 11W.-3 shows treatment Option No. 3 which proposes a D.E. Filtration System with activated carbon as a pre-coat aid. This plan includes the construction of a new treatment facility to accommodate the new system and renovation of the existing system to operate as a standby facility. The costs shown in Table 11W.-1 include construction of a new building, laboratory, and office space. The estimated cost of the D.E. Filter System alone is about $120,000 for two filters, completely automated.

Proposed construction of the new facility includes:

1. Construction of a new masonry block building 40'x40' to house the D.E. Filter System. Two pressure filters will be required initially, and enough space should be provided for two more in the future.

2. Construct a completely automated D. E. Pressure Filter System, composed of two pressure filters with a filtering capacity of 1200 g.p.m. each.

3. Construct a new chlorination system in the new facility.

4. Construct a new fluoridation system in the new facility.

5. Replace the existing high service pumps, piping and metering system with a new system that totalizes, indicates and records.

6. Renovate or replace the existing internal wiring and controls system to adequately operate the high service pumps in the existing plant.

7. Patch and repair the existing clear well for use by the new facility.

8. Renovate, remodel and repipe the existing treatment plant to make it an adequate and reliable standby treatment plant.

Features of this plan are:

1. By renovating parts of the existing plant specifically the clear well and high service pumps, it can be kept in useful service and reduce the added costs of construction. The clear well is an adequate structure and there is no need to construct a new clear well, provided that all of the leaks are properly sealed.

2. The completely automated D.E. Filter System will provide the finest filtration system available. It will remove 99% of the bacteria and most of the virus. The capability of adding activated carbon to the precoat will give the plant the additional versatility to remove most taste and odor causing compounds, and 25 to 50 percent of the color. The automatic operation of the system will reduce the need for full time operator input. The regenerative capability of the filter will allow the operator the choice of flushing away the spent D.E. each time the filter is backwashed, or reusing the D.E.

3. Replacing the existing high service pumps and metering system will allow monitoring of the water produced, and evaluation of the efficiency of the pumps.

4. By renovating part of the existing plant, it can serve as an adequate standby treatment plant.

The existing standby 240 volt power generator is capable of running the existing plant, at the power presently required. This saves the cost of building a standby power generator into the new plant. The estimated costs for renovating the existing plant as a standby and the cost for buying, installing and maintaining a generator capable of supplying the power required by the new plant are approximately the same. However, a program of maintaining the existing generator must be set up so that the generator can serve its purpose.

5. Renovation of the existing plant to make it a reliable standby plant will include rebuilding of the underdrain system and replacement of the existing rapid sand filter media with mixed media. Thus one filter can be renovated to produce the same amount of water as the entire plant can now with two rapid sand filters in operation. The costs of this type of renovation can easily be justified since full scale renovation is not required.

6. The new chlorination system would be built in accordance with the latest safety rules and procedures. Thus a safer more reliable system will be utilized.

7. The estimated cost of construction is $750,000.

8. Color removal would not be complete.

D. <u>Treatment Option No. 4</u>

Treatment Option No. 4 is schematically shown in Fig. 11W.-4. The system involves D.E. Filtration for turbidity and partial color removal, followed by ozonation for color removal and complete disinfection, and then finally, residual chlorination.

This is the treatment option that we feel will give the most versatility in treatment operations, and produce the highest quality water available, and the one the Joint Powers Board has selected.

The proposed system consists of the under river backwashable infiltration gallery which will provide the initial prefiltration of particulates and turbidity to a level of 5.0 J.T.U. or less. The water will then be pumped to the D.E. Filtration system for polishing filtration, i.e., fine filtration of the water, for removal of the remaining turbidity, bacteria and virus, and 25 percent of the color. The polished water will then be ozonated in deep ozone contact chambers to provide color, taste and odor removal, complete disinfection, and some iron and manganese removal. From there, the finished water will be pumped into the clear well where the finely polished water will be chlorinated to maintain a chlorine residual of 1.0 p.p.m. in the finished water leaving the plant. Two high service pumps will pump the water from the clear well into the distribution system, and on to storage.

In addition to constructing the new treatment facility, this plan includes renovation of the existing treatment plant to be used as a standby facility in times of power shortages, etc. as discussed in Treatment Option No. 3.

Recommended construction would include:

1. Construction of a 60 x 60 masonry block building large enough to house the proposed D.E. filter system, ozone system, laboratory, office space, and allow for easy expansion of the facility for Construction Phase II.

2. Construction of a complete D.E. Pressure Filter System capable of filtering 2400 g.p.m. at normal operating rates, completely automated.

3. Construction of a complete ozone generating system contact structure, dissolution and off gas destruct

system, capable of producing 36 lbs. of O_3 per day and expandable.

4. Construction of a completely new chlorination system for residual chlorination.

5. Construction of a new clear well structure and high service pumping system completely metered for totalizing, indicating and recording.

6. Construction of a new fluoridation system.

7. Renovation of the existing filter plant to make it a completely adequate standby system, including the standby electrical generator. Renovation includes those items discussed in Treatment Option No. 3.

Features of this plan are:

1. By constructing a new water treatment facility, all dependence on the existing facility for operation is avoided. The new facility will cost more for construction, but the entire operation will be contained in one structure.

2. The completely automated D.E. pressure filter system will provide the finest filtration system available and will be capable of removing 25% of the color, taste and odor causing compounds, etc. prior to ozonation. This prefiltration will greatly reduce the demand for ozone in the filtered water, and thus less ozone will be required for color removal. The D.E. filter system proposed is the same as that of Treatment Option No. 3.

3. By constructing an ozonation system that follows the filtration process, complete color removal, taste and odor removal and disinfection is expected. The ozone system recommended will be capable of adding 36 p.p.d. The new ozone system will require a contacting structure 18 to 20 feet deep. It is for this reason that a new clear well

structure can be more economically proposed with this treatment option. The contact structure will be large enough to handle the flows for Construction Phase II as well as I.

4. By having ozone primarily as a color oxidizing agent, the high doses of ozone required for color removal will secondarily insure complete disinfection as well. Therefore, the costs and needs for a sophisticated chlorination system will be reduced. The chlorination system proposed will simply add enough chlorine to comply with the State D.E.Q. Standards of providing 1 mg/l in the treatment plant effluent.

5. Construction of a fluoridation system is inexpensive, and will aid in reduction of dental caries.

6. Construction of a new clear well structure is made feasible by the need for a deep underground ozone contact chamber. The clear well will be smaller than the existing clear well but will be constructed water tight. When the existing clear well has been patched and made water tight, the two clear wells can be connected with a valve to increase their storage capacity to approximately 125,000 gallons.

7. By renovating the existing water treatment plant, it can be used as an adequate standby plant. The reasons and methods for renovating the existing plant were discussed in Treatment Option No. 3. In addition to those reasons, a large factor influencing renovation in both Option 3 and 4 are the facts surrounding the existing standby power generator. It is imperative in the design of any new water treatment facility to supply a backup power source. The existing standby power generator is not capable of producing the power requirements that would be demanded by the new plants in Options 3 and 4. The existing generator is 240 V. and can only produce 50 KW. The

power requirement of the new plant will be 480 volt power and consume as much as 125 KW at one half operating capacity and 250 KW at maximum operating capacity. As stated previously, it is estimated that the cost of providing a new standby generator to handle the power requirements of a new plant are the same as the estimated cost of renovating the existing water treatment plant to operate as a standby plant. The benefits of having an additional standby 1 M.G.D. plant far outweigh those of having a new standby generator, so we recommend renovation of the existing facility including the backup power system.

8. The estimated cost of construction is $850,000.

E. Treatment Option No. 5

Treatment Option No. 5 involves adding an additional coagulation-filtration system to the one that now exists. This expansion involves the addition of new coagulation-flocculation basins and new filter beds. The expansion would provide for a capacity of 3.25 M.G.D. now and expansion to a capacity of 6.5 M.G.D. in Construction Phase II. This proposal is similar to the one made by J.T. Banner and Assoc. in 1974.(12)

Recommended construction for this proposed plan includes:

1. Complete renovation of the existing treatment plant to make it a modern chemical/coagulating treatment plant.

2. Construction of a new facility similar to the existing plant, with a capacity of 2.25 M.G.D.

3. Construction of a modern chlorination system.

4. Construction of a modern fluoridation system.

Features of this plan include:

1. Renovation of the existing plant with mixed media filtration, to increase its capacity to 2.0 M.G.D. This renovation includes major repiping, repumping and electrical construction to increase the plants capacity and make it modern.

2. Construction of a new facility capable of treating 1.45 M.G.D. and expandable to 6.5 M.G.D. Construction for Phase I includes one new clarifier, 1 new mixed filter bed, approximately 200 square feet, a new chlorination system, a new fluordiation system and completely automating the existing and proposed systems. Construction for Phase II would require 2 additional filters one and one half times larger than the existing filters, and another clarifier, etc.

3. The use of the existing facility again saves the cost for new construction. However, the additional construction costs required for a new coagulation type treatment plant are high, as more space is required and more sophisticated construction is involved. The costs of building onto this plant for Phase II will be high.

4. The fact that a coagulation type of treatment is proposed does not insure that color will be completely removed. In addition, the maintenance and operating costs for a coagulating plant will be high particularly during the troublesome months of March through June.

5. The estimated construction cost of this option is $1,300,000 now[12] and much higher in Phase II. In view of this fact, and in comparison to the advantages offered by Treatment Option No.'s 3 and 4, this option is not economically feasible.

5A. By adding onto the existing treatment plant with a 1.45 M.G.D. D.E. Filtration System similar to the D.E. Filter System proposed in Options 3 and 4, the costs for initial construction can be somewhat reduced for Phase I and greatly reduced for Phase II. However, it still requires additional facility construction, and thus increased costs.

In addition, two different types of treatment techniques would be used and necessitate an operator skilled in both processes, and thus additional operation and maintenance costs.

The estimated cost of construction for this option is $1,050,000 and again is not economically feasible.

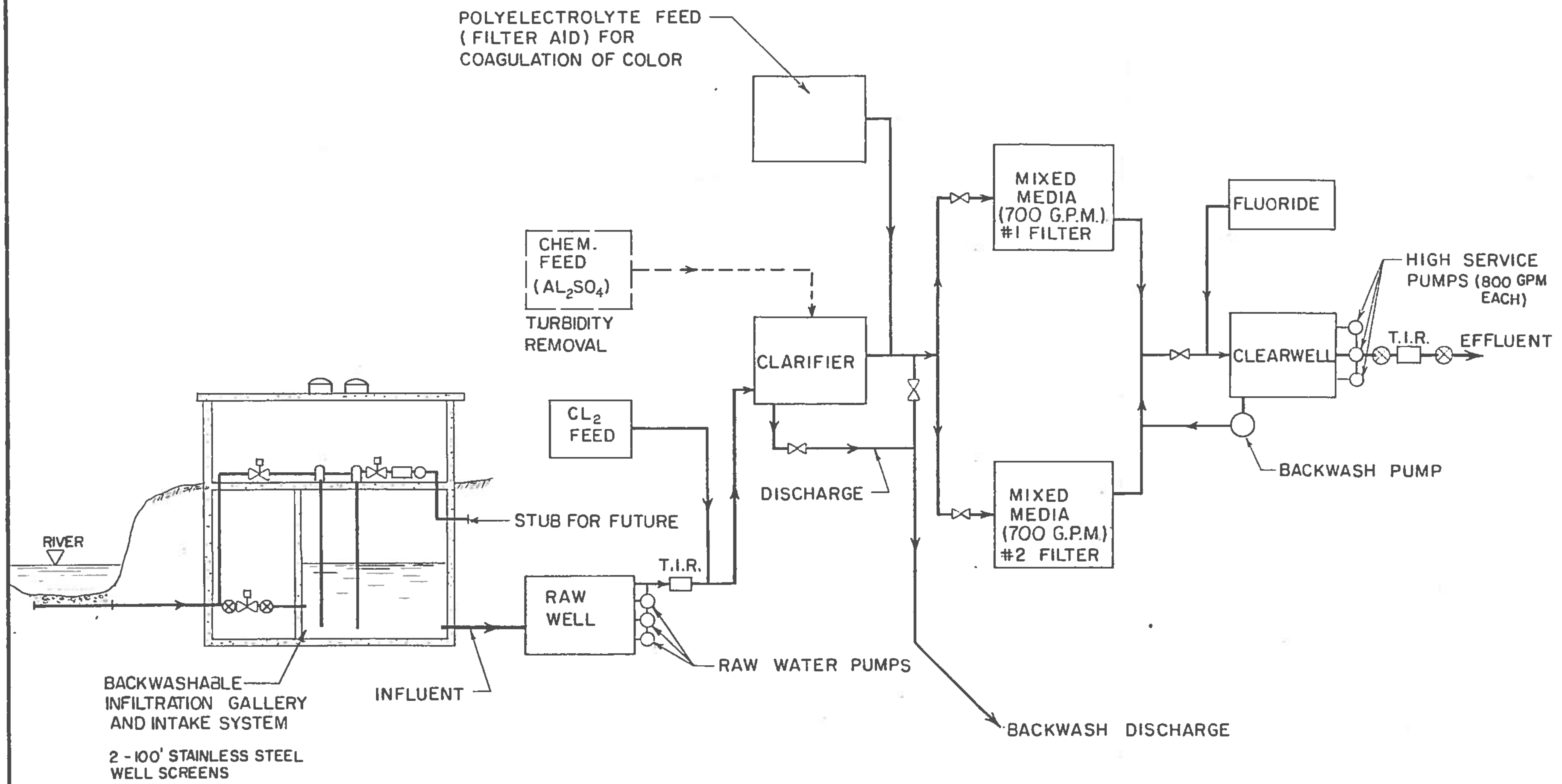


FIG. IIW-I
TREATMENT OPTION NO. I

SCHEMATIC FLOW DIAGRAM —
MIXED MEDIA FILTRATION & PLANT RENOVATION

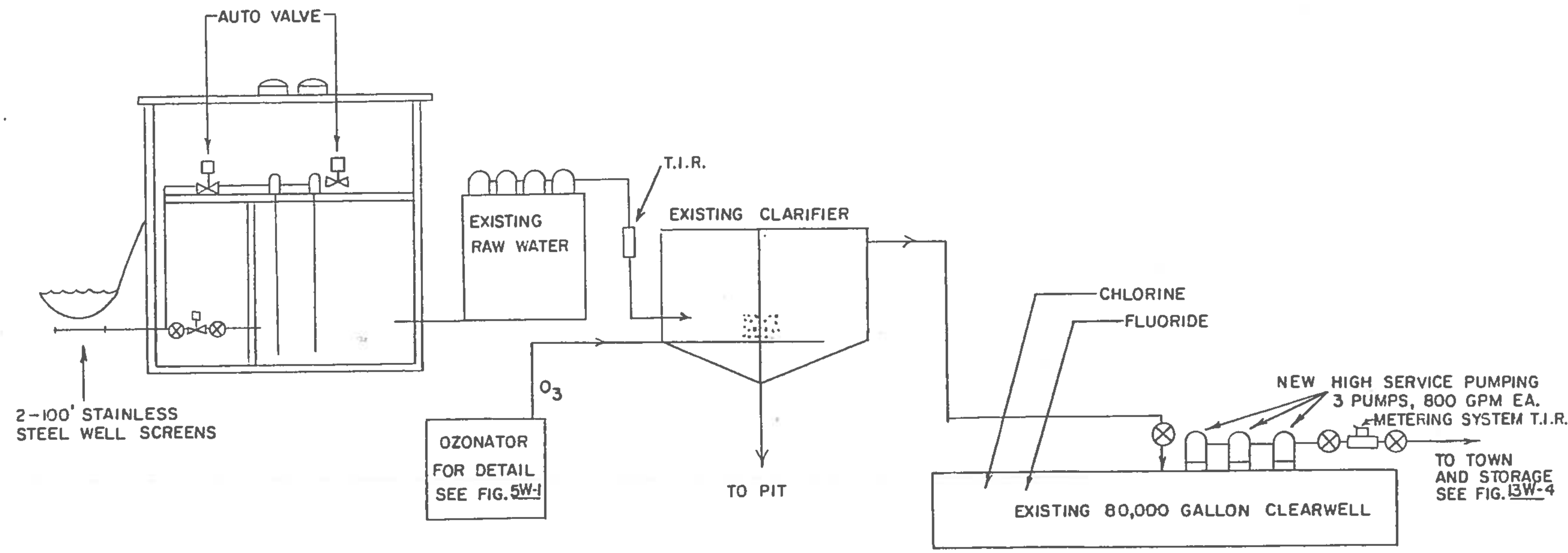


FIG. 11W-2

TREATMENT OPTION NO. 11

SCHEMATIC FLOW DIAGRAM

OZONATION FOLLOWED BY RESIDUAL CHLORINATION

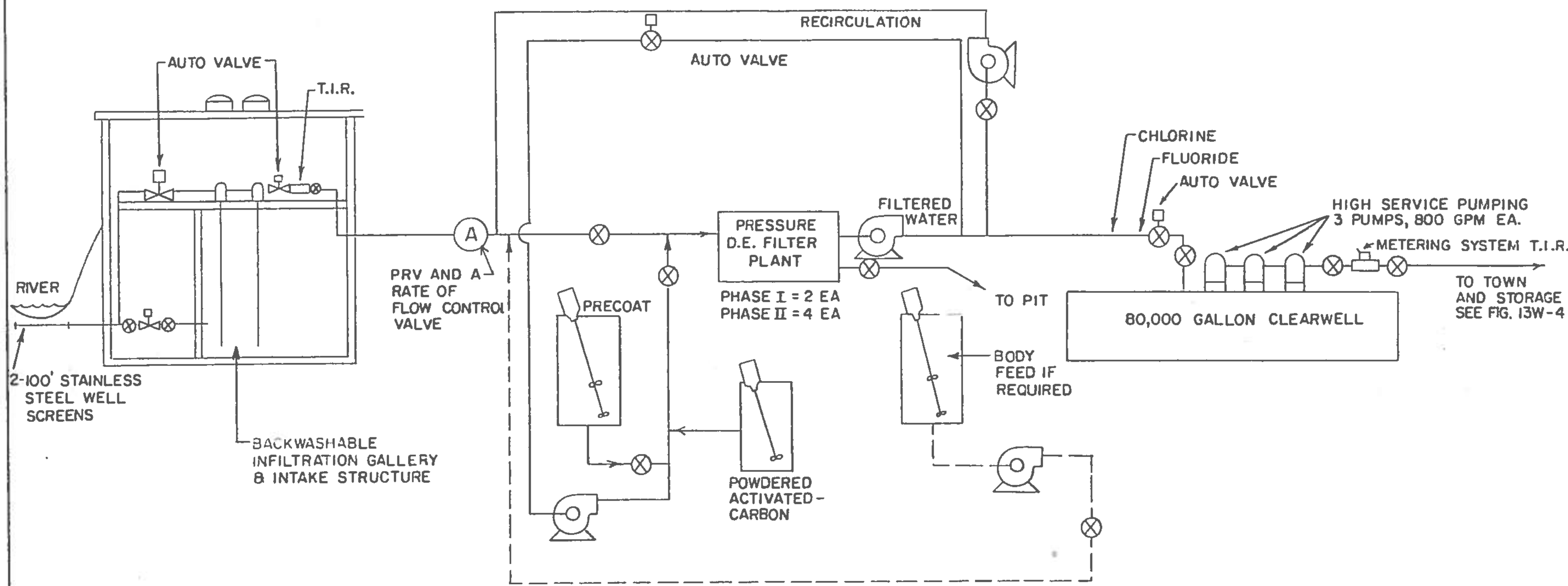


FIG. 11W-3

TREATMENT OPTION NO. III

SCHEMATIC FLOW DIAGRAM

D.E. FILTRATION, WITH ACTIVATED CARBON AS A PRECOAT AID

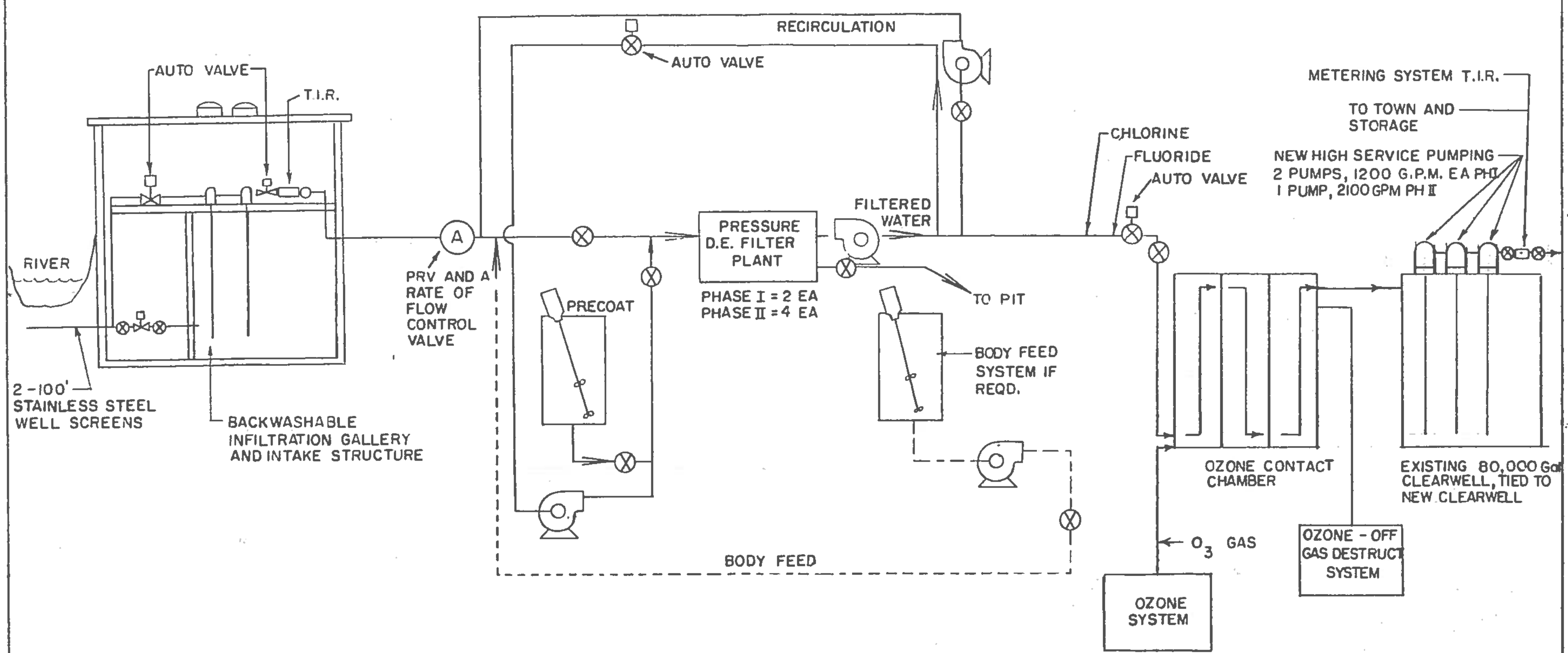


FIG. IW-4

TREATMENT OPTION NO. IV

SCHEMATIC FLOW DIAGRAM
D.E. FILTRATION FOLLOWED BY OZONATION AND RESIDUAL CHLORINATION

CHAPTER 12W. - DISTRIBUTION SYSTEM

The scope of this chapter is to describe and evaluate the existing water distribution and storage system. Much of this information is shown on the Figures 12W.-3 and 12W.-6, so that not a great deal of detail will be discussed here.

Description of the Existing Distribution System

The treated water that leaves the existing water treatment plant is pumped into a 10 inch diameter cast iron pipe which serves as a feeder line to the entire Town. A six inch dia. line tees off from this 10 inch dia. line just outside the plant and runs east across the river to service the east side of Saratoga. This line has recently been abandoned due to severe leakage problems and has been replaced with a 12 inch dia. ductile iron line constructed in the summer of 1977, see also Fig. 9W.-5.

The 10 inch dia. feeder line feeds indirectly into the 0.25 M.G. elevated water storage tank. As shown on the map the 10 inch dia. line is necked down to a two inch line on 3rd St. and Spring Ave. On 3rd St., a 6 inch dia. cast iron main takes off from the 10 inch and runs south across the Airport to the old water storage tank South of Town. From this 6 inch line, a 4 inch dia. water main is run east to Cedar Street and serves that area of Country Club Heights Addition.

The Town is not metered. Only nine meters have been installed in Town and these are located at the motels, trailer courts, lumber company, etc., not on individual residences.

Evaluation of the Existing Distribution System

A distribution system should comply with good engineering design practices, health and safety standards, and State and local codes. Some important design criteria that a system should meet were summarized in Chapter 2W., and more are included or repeated here:

1. All distribution piping should be sized no smaller than 6 inch diameter to insure adequate pressure and volume of flow for fire protection.

2. As many lines as feasible in a distribution system should be looped to prevent service interruptions during line shut downs and to prevent stagnation of the water system.

3. The proper valving should exist so that isolation of a small portion of the system can occur without shutting down large portions of the system.

4. Fire hydrants should be so located as to adequately provide fire protection access for any home or business, and color coded to indicate their flow volume.

5. Large mains should be located to allow proper flows to adequately feed all areas of the existing Town, and be easily expandable to future areas of growth. A growing Town needs a system of large, looped mains to maintain present flows and provide easy access for flows to future areas.

The existing distribution system in Saratoga is in violation of all of the above mentioned standards. The central parts of Town have undergone some 2 and 4 inch. dia. line replacement but many undersized lines remain to be replaced. There are very few looped lines, very few adequately spaced valves, and a scarcity of fire hydrants.

Many of the lines in Saratoga are not buried to provide frost protection. Some of the valves shown on the maps have never been located. Many valves are old, and don't close easily or completely. Many of the fire hydrants that do exist are old, inoperable and tied onto 2 and 4 inch dia. feeder lines. Many lines have been constructed of inferior water line materials.

As a result of all of the problems and short comings mentioned above, W.E.A.I. feels that the Town's distribution system is totally inferior and inadequate. Complete or reliable fire protection does not exist. In addition none of the Town is metered, and this condones water wasting. Installation of meters will be difficult to accomplish as most centrally located homes have no crawl spaces. Many of the service tap materials are different, and installation will require special fittings for particular locations. However, meters are a necessity if the Town is to grow to 5000 people before Construction Phase II is required.

Recommended Construction

The recommended construction and suggested water line and looped mains, hydrants and valving are shown on the Figs. 12W.-4 & 5,12W.-7 & 8 and 12W.-9. Some existing valve locations are shown in the Appendix. Proposed construction can be summarized as follows:

1. Replace all 2 and 4 inch. dia. water lines throughout the Town with 6 and 8 inch mains capable of supplying the flows at pressures required for fire protection.

2. Provide meters on all services, using a uniform meter and recording system. The meter shall be one that is flexible enough to withstand the sand and pressure problems that exist, and can fit the varied building conditions expected to be encountered. The majority of the newer houses and all new construction can be put onto a remote readout system with the meter located in the house and the meter totals indicated outside. The older houses, with no easily accessible way to install meters inside, will require special treatment such as frostproof meter cans located on the property line. Estimated construction costs are shown in Table 12W.-2.

3. Provide color coded fire hydrants where required to provide reliable fire protection, tie all hydrants presently on 2 and 4 inch lines to 6 inch dia. or larger lines, and replace all old and faulty hydrants that now exist. Color coding of the hydrants shall be that called out in AWWA Standard C503-70, "Uniform Color Scheme for Fire Hydrants". Hydrants shall be classed and coded as follows:

   a. Class A - Hydrants that on individual tests usually have a flow capacity of 1000 g.p.m. or greater. Paint the barrel chrome yellow, paint tops and nozzle caps green.

   b. Class B - Hydrants that on individual tests usually have a flow capacity of 500 to 1000 g.p.m. Paint barrel chrome yellow, paint tops and nozzle caps orange.

c. Class C - Hydrants that on individual tests usually have a flow capacity of less than 500 g.p.m. Paint barrel chrome yellow, paint tops and nozzle caps red.

4. Provide loops for all lines, and install new valving, preferably butterfly valves, on these loops and on the present lines, so that when shut downs are required, small areas may be shut off instead of major portions of the Town.

5. Provide a 12 inch dia. main looping the entire Town and complete a looped main across the river for the eastern part of Town. This loop will be capable of future expansion of service to outer areas of Town, and provide water from two directions across the river.

Estimated construction costs for the 1978 Improvements shown on the Plans are shown in Table 12W.-1 and 12W.-2, and based on actual bid prices received on recent water line construction projects in Saratoga.

Section L of Appendix shows the locations of the valves on the Towns distribution system. This information has been supplied by the Public Works Deparment. In addition to the above recommended construction it is our strong recommendation that the Public Works Department accurately locate all valves shown on the Figures, and all new valving to be constructed in the future. The valves on the water mains and those on fire hydrants should be routinely opened and closed two or three times a year to insure their dependability. Leaky valves or poorly operating valves should be repaired or replaced. Fire hydrant flows should be measured, and the hydrants color coded.

TABLE 12W.-1

COST ESTIMATE FOR PROPOSED 1978 WATER IMPROVEMENTS

ITEM	DESCRIPTION	UNIT		UNIT PRICE	EXTENSION
1	12" Class 52 D.I.P.	8,250	l.f.	22.00	$ 181,500.00
2	12" Class 52 D.I.P. River Crossing, slough	850	l.f.	75.00	63,750.00
3	10" Main, Class 52 D.I.P.	2,370	l.f.	20.00	47,400.00
4	8" Class 150 P.V.C. main	3,300	l.f.	15.00	49,500.00
5	6" Class 150 P.V.C. new lines and replacements	31,900	l.f.	15.00	478,500.00
6	12" Butterfly valves & risers	12	ea.	1000.00	12,000.00
7	10" Butterfly valves & risers	10	ea.	850.00	8,500.00
8	8" Butterfly valves & risers	7	ea.	600.00	4,200.00
9	6" Butterfly valves & risers	170	ea.	400.00	68,000.00
10	Install 4" B.F. valves & risers in existing lines	10	ea.	800.00	8,000.00
11	Fire hydrants	114	ea.	1000.00	114,000.00
12	Ties to existing mains	70	ea.	1000.00	70,000.00
13	Fittings, tees & Misc.	L.S.		50000.00	50,000.00
14	Ditch Crossings (3)	3	ea.	1200.00	3,600.00
15	Replacing Service Taps	12,000	l.f.	7.00	84,000.00
16	Curb box and risers	300	ea.	75.00	22,500.00
17	4" bedding and 1' cover	45,690	l.f.	1.50	68,538.00
18	3"x30' wide base rock	43,230	l.f.	1.00	43,230.00
19	Pressure reducing valve stations	7	ea.	8000.00	56,000.00
20	Highway Crossings & Repair	2,110	l.f.	50.00	105,500.00

Sub Total Construction Costs =	$1,538,718.00
15% Contingency (Construction)	230,808.00
6.25% Engineering Fee	110,595.00
1.5 % Surveying	26,543.00
3% Inspection	53,086.00
Advertising, legal, administration fees	4,000.00
TOTAL =	$1,963,750.00
USE	$2,000,000.00

TABLE 12W.-2

COST ESTIMATES - WATER METERS

	DESCRIPTION	UNIT	UNIT PRICE	EXTENSION
1	Meter in meter pit	375 ea.	$400.00	$150,000.00
2	Meter with outside readout	375 ea.	200.00	75,000.00

Sub Total Construction	=	$225,000.00
10% Contingency	=	22,500.00
6.2% Engineering	=	15,345.00
3% Inspection	=	7,425.00
Advertising, legal,		4,000.00
& admin.	=	4,000.00
		$274,270.00
	USE	$275,000.00

Fig. 12W-1

14 Inch Diameter M.J.D.I.P. Pipe Strung Along River Street-1977

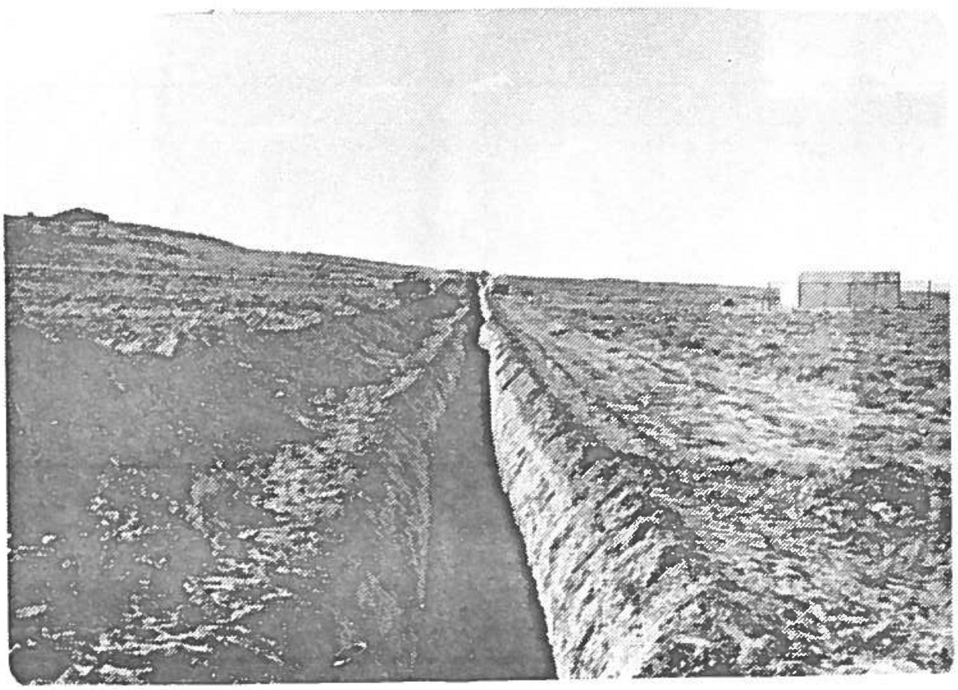
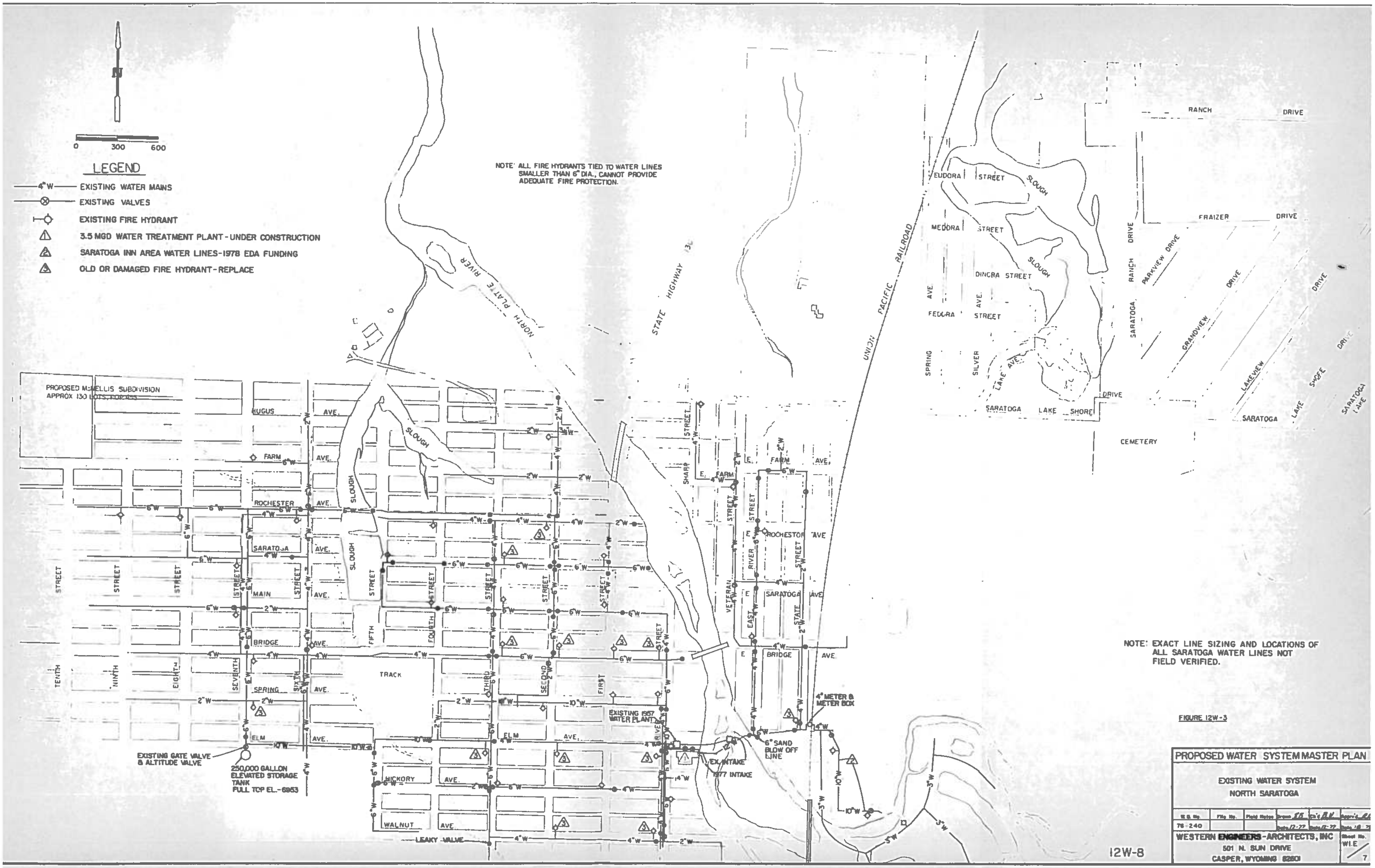


Fig. 12W-2

Pipe Trench Dug Along Airport Avenue for 14 Inch Water Main-1977



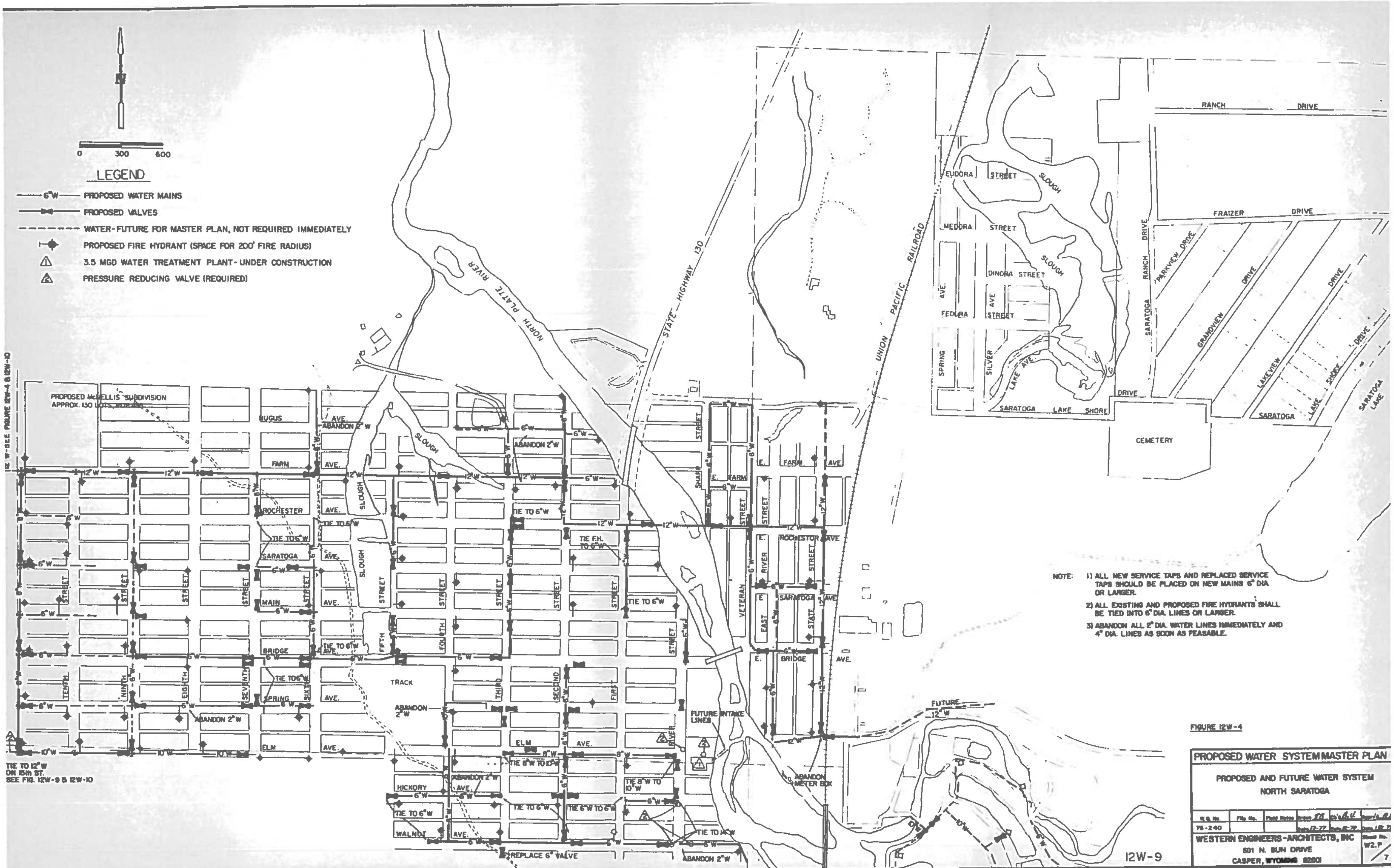
PROPOSED WATER SYSTEM MASTER PLAN

EXISTING WATER SYSTEM
NORTH SARATOGA

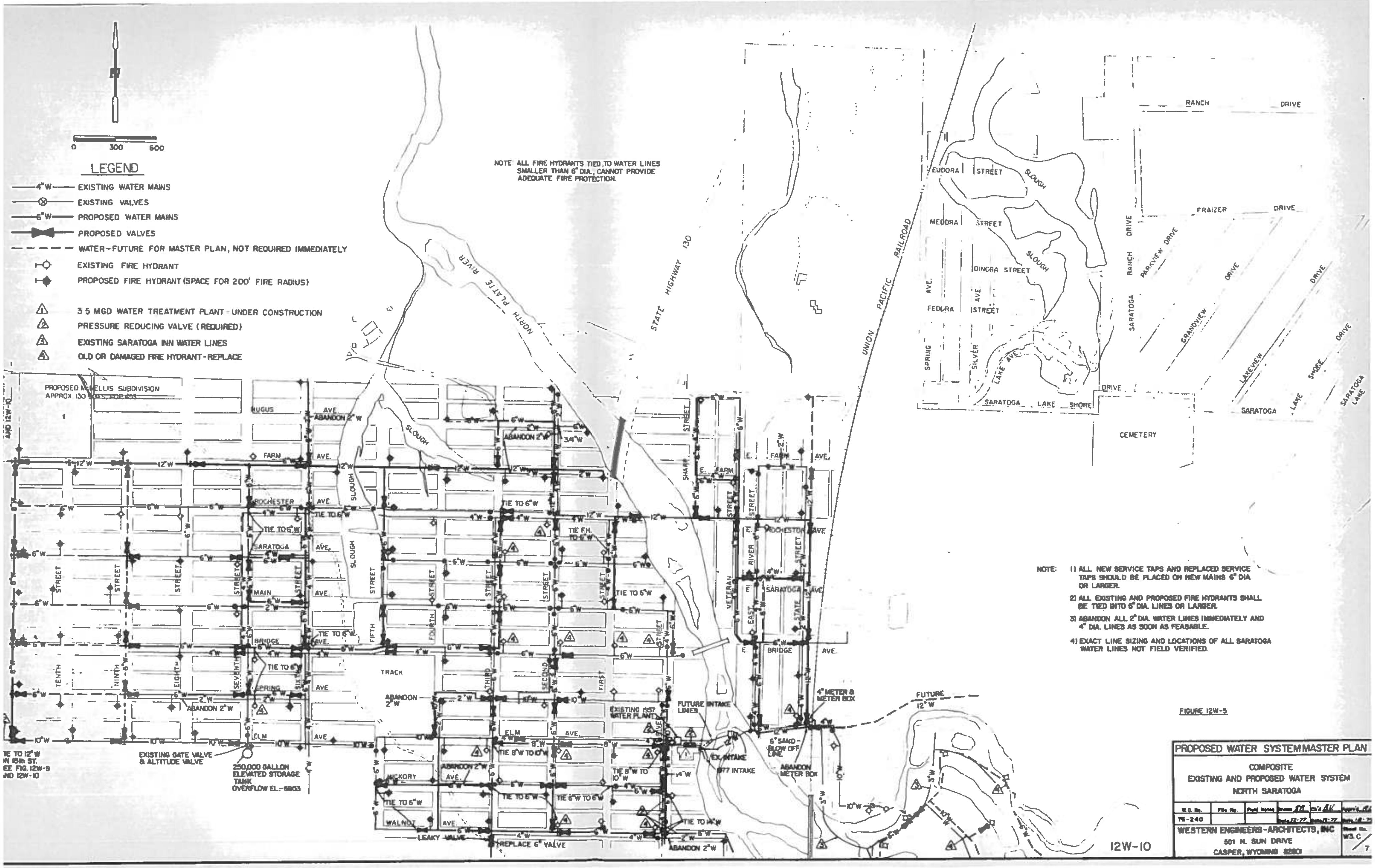
W.E. No.	File No.	Field Notes	Drawn	Ch'd	Appr'd
76-240			Date 12-77	Date 12-77	Date 12-77

WESTERN ENGINEERS - ARCHITECTS, INC
501 N. SUN DRIVE
CASPER, WYOMING 82601

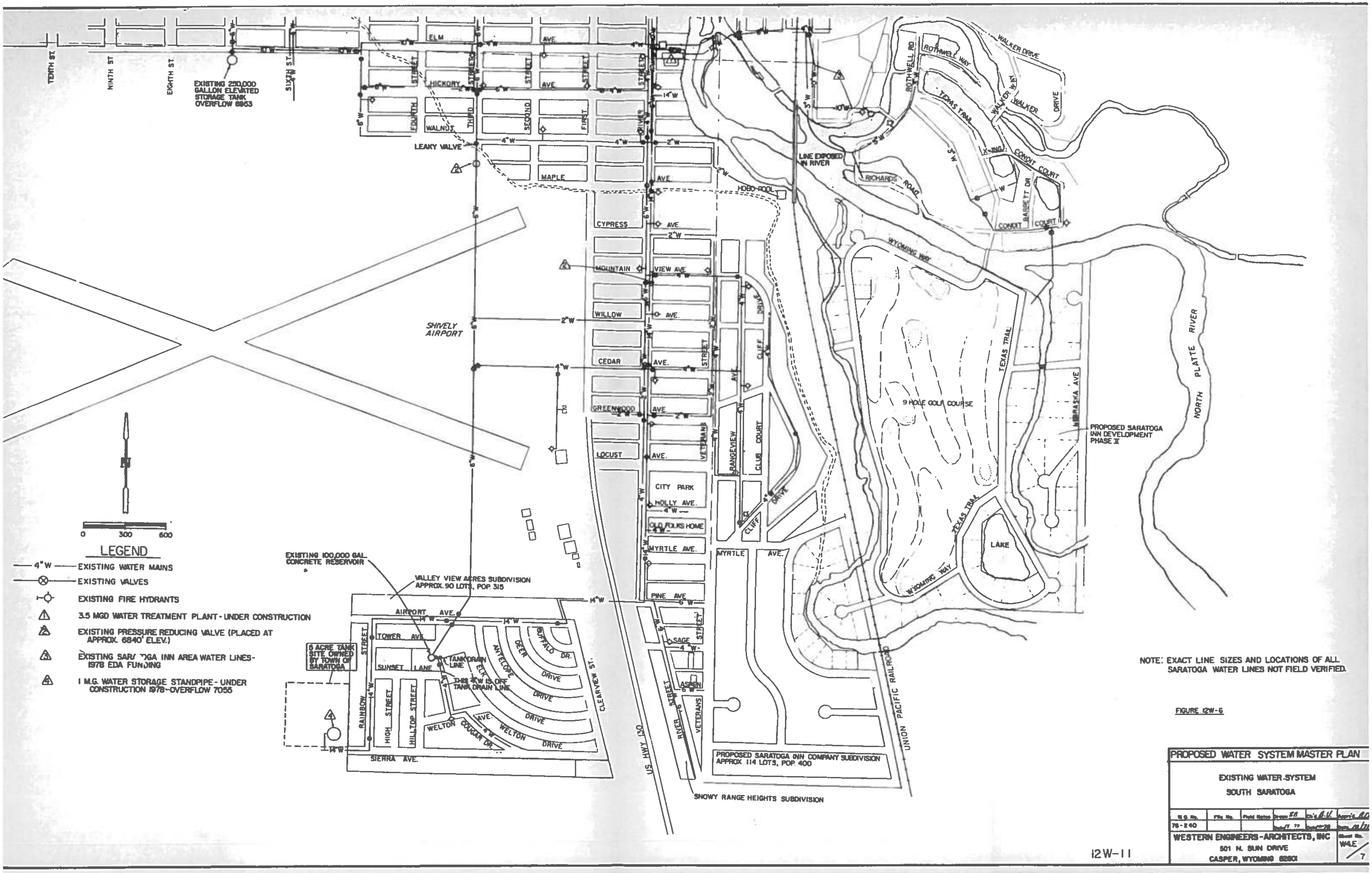
Sheet No. W.I.E. 7



LEGEND
0 300 600
6"W PROPOSED WATER MAINS
PROPOSED VALVES
WATER-FUTURE FOR MASTER PLAN, NOT REQUIRED IMMEDIATELY
PROPOSED FIRE HYDRANT (SPACE FOR 200' FIRE RADIUS)
3.5 MGD WATER TREATMENT PLANT- UNDER CONSTRUCTION
PRESSURE REDUCING VALVE (REQUIRED)
NORTH PLATTE RIVER
STATE HIGHWAY 130
UNION PACIFIC RAILROAD
SLOUGH
PROPOSED McMELLIS SUBDIVISION
TRACK
CEMETERY
RANCH DRIVE
FRAIZER DRIVE
SARATOGA RANCH DRIVE
PARKVIEW DRIVE
GRANDVIEW DRIVE
LAKEVIEW DRIVE
SARATOGA LAKE SHORE DRIVE
SARATOGA LAKE
EUDORA STREET
MEDORA STREET
DINORA STREET
FEDORA STREET
SPRING AVE.
SILVER AVE
LAKE AVE.
E. FARM AVE.
E. ROCHESTOR AVE
E. SARATOGA AVE
E. BRIDGE AVE.
SHARP STREET
VETERAN STREET
E. RIVER STREET
EAST STREET
STATE STREET
FIRST STREET
SECOND STREET
THIRD STREET
FOURTH STREET
FIFTH STREET
SIXTH STREET
SEVENTH STREET
EIGHTH STREET
NINTH STREET
TENTH STREET
BUGUS AVE.
FARM AVE.
ROCHESTER AVE.
SARATOGA AVE.
MAIN AVE.
BRIDGE AVE.
SPRING AVE.
ELM AVE.
HICKORY AVE.
WALNUT AVE.
12"W
10"W
8"W
6"W
ABANDON 2"W
TIE TO 6"W
TIE F.H. TO 6"W
TIE 6"W TO 10"W
TIE 8"W TO 10"W
TIE TO 14"W
REPLACE 6" VALVE
FUTURE INTAKE LINES
ABANDON METER BOX
FUTURE 12"W
TIE TO 12"W ON 15th ST. SEE FIG. 12W-9 & 12W-10
12W-9
NOTE: 1) ALL NEW SERVICE TAPS AND REPLACED SERVICE TAPS SHOULD BE PLACED ON NEW MAINS 6" DIA OR LARGER.
2) ALL EXISTING AND PROPOSED FIRE HYDRANTS SHALL BE TIED INTO 6" DIA. LINES OR LARGER.
3) ABANDON ALL 2" DIA. WATER LINES IMMEDIATELY AND 4" DIA. LINES AS SOON AS FEASABLE.
FIGURE 12W-4
PROPOSED WATER SYSTEM MASTER PLAN
PROPOSED AND FUTURE WATER SYSTEM
NORTH SARATOGA
78-240
WESTERN ENGINEERS-ARCHITECTS, INC
501 N. SUN DRIVE
CASPER, WYOMING 82601
W2.P



0 300 600
LEGEND
4"W EXISTING WATER MAINS
EXISTING VALVES
6"W PROPOSED WATER MAINS
PROPOSED VALVES
WATER-FUTURE FOR MASTER PLAN, NOT REQUIRED IMMEDIATELY
EXISTING FIRE HYDRANT
PROPOSED FIRE HYDRANT (SPACE FOR 200' FIRE RADIUS)
3.5 MGD WATER TREATMENT PLANT - UNDER CONSTRUCTION
PRESSURE REDUCING VALVE (REQUIRED)
EXISTING SARATOGA INN WATER LINES
OLD OR DAMAGED FIRE HYDRANT - REPLACE
NOTE: ALL FIRE HYDRANTS TIED TO WATER LINES SMALLER THAN 6" DIA., CANNOT PROVIDE ADEQUATE FIRE PROTECTION.
NORTH PLATTE RIVER
STATE HIGHWAY 130
UNION PACIFIC RAILROAD
SLOUGH
CEMETERY
PROPOSED McELLIS SUBDIVISION APPROX 130 LOTS
250,000 GALLON ELEVATED STORAGE TANK OVERFLOW EL.-6953
EXISTING GATE VALVE & ALTITUDE VALVE
EXISTING 1957 WATER PLANT
FUTURE INTAKE LINES
EX. INTAKE
1977 INTAKE
4" METER & METER BOX
6" SAND-BLOW OFF LINE
ABANDON METER BOX
FUTURE 12"W
LEAKY VALVE
REPLACE 6" VALVE
NOTE:
1) ALL NEW SERVICE TAPS AND REPLACED SERVICE TAPS SHOULD BE PLACED ON NEW MAINS 6" DIA OR LARGER.
2) ALL EXISTING AND PROPOSED FIRE HYDRANTS SHALL BE TIED INTO 6" DIA. LINES OR LARGER.
3) ABANDON ALL 2" DIA. WATER LINES IMMEDIATELY AND 4" DIA. LINES AS SOON AS FEASABLE.
4) EXACT LINE SIZING AND LOCATIONS OF ALL SARATOGA WATER LINES NOT FIELD VERIFIED.
FIGURE 12W-5
PROPOSED WATER SYSTEM MASTER PLAN
COMPOSITE
EXISTING AND PROPOSED WATER SYSTEM
NORTH SARATOGA
76-240
WESTERN ENGINEERS-ARCHITECTS, INC
501 N. SUN DRIVE
CASPER, WYOMING 82601
W3.C
12W-10


PROPOSED WATER SYSTEM MASTER PLAN
EXISTING WATER SYSTEM
SOUTH SARATOGA
76-240
WESTERN ENGINEERS-ARCHITECTS, INC
501 N. SUN DRIVE
CASPER, WYOMING 82601
FIGURE 12W-6
NOTE: EXACT LINE SIZES AND LOCATIONS OF ALL SARATOGA WATER LINES NOT FIELD VERIFIED.
LEGEND
0 300 600
4"W EXISTING WATER MAINS
EXISTING VALVES
EXISTING FIRE HYDRANTS
3.5 MGD WATER TREATMENT PLANT - UNDER CONSTRUCTION
EXISTING PRESSURE REDUCING VALVE (PLACED AT APPROX. 6840' ELEV.)
EXISTING SARATOGA INN AREA WATER LINES - 1978 EDA FUNDING
1 M.G. WATER STORAGE STANDPIPE - UNDER CONSTRUCTION 1978 - OVERFLOW 7055
EXISTING 250,000 GALLON ELEVATED STORAGE TANK OVERFLOW 6953
EXISTING 100,000 GAL. CONCRETE RESERVOIR
VALLEY VIEW ACRES SUBDIVISION APPROX. 90 LOTS, POP. 315
5 ACRE TANK SITE OWNED BY TOWN OF SARATOGA
PROPOSED SARATOGA INN COMPANY SUBDIVISION APPROX 114 LOTS, POP. 400
SNOWY RANGE HEIGHTS SUBDIVISION
PROPOSED SARATOGA INN DEVELOPMENT PHASE II
9 HOLE GOLF COURSE
LAKE
NORTH PLATTE RIVER
UNION PACIFIC RAILROAD
US HWY 130
SHIVELY AIRPORT
LEAKY VALVE
LINE EXPOSED IN RIVER
HOBO POOL
CITY PARK
OLD FOLKS HOME
TANK DRAIN LINE
THIS 4"W IS OFF TANK DRAIN LINE
12W-11

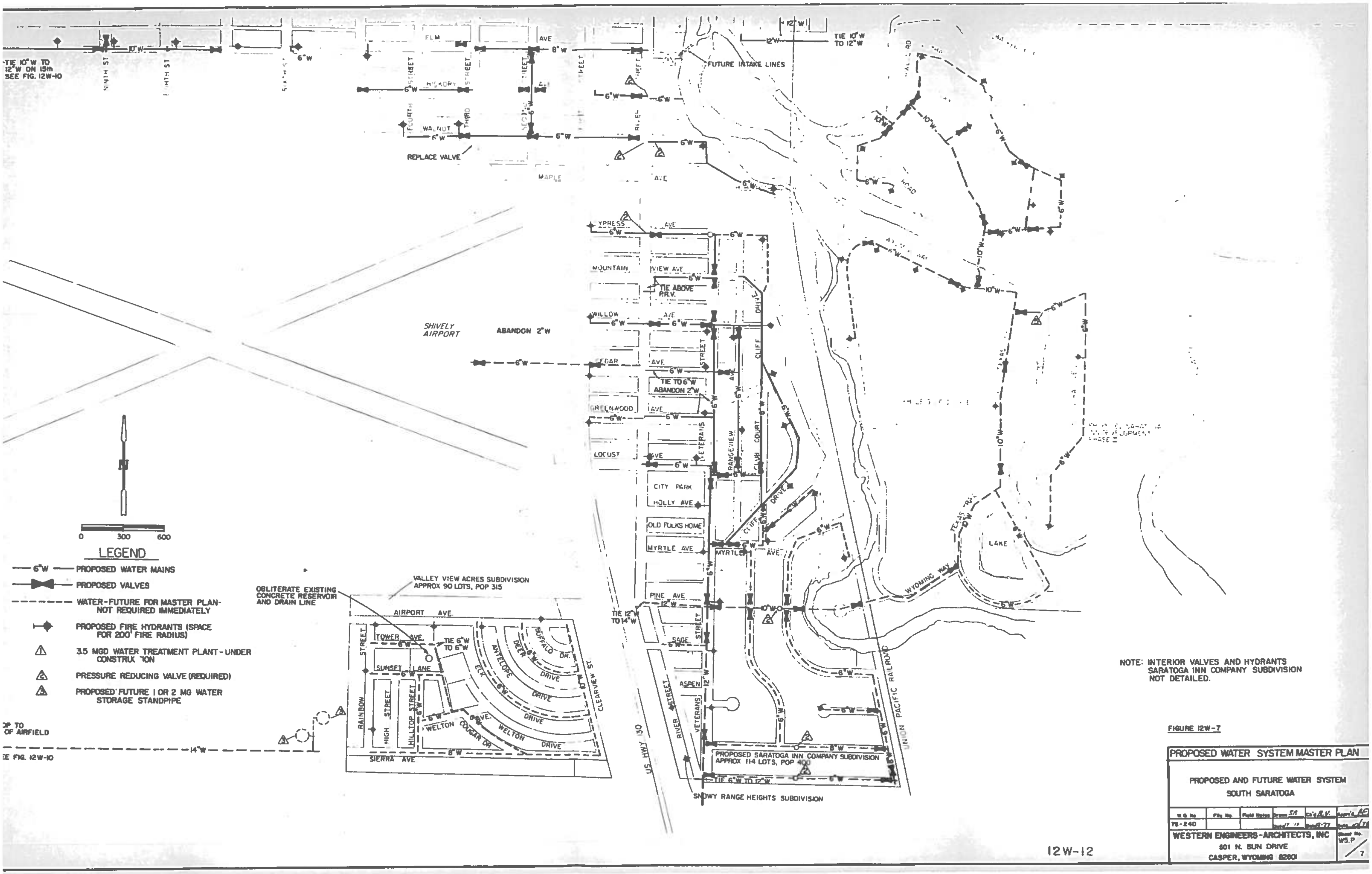


FIGURE 12W-7

PROPOSED WATER SYSTEM MASTER PLAN

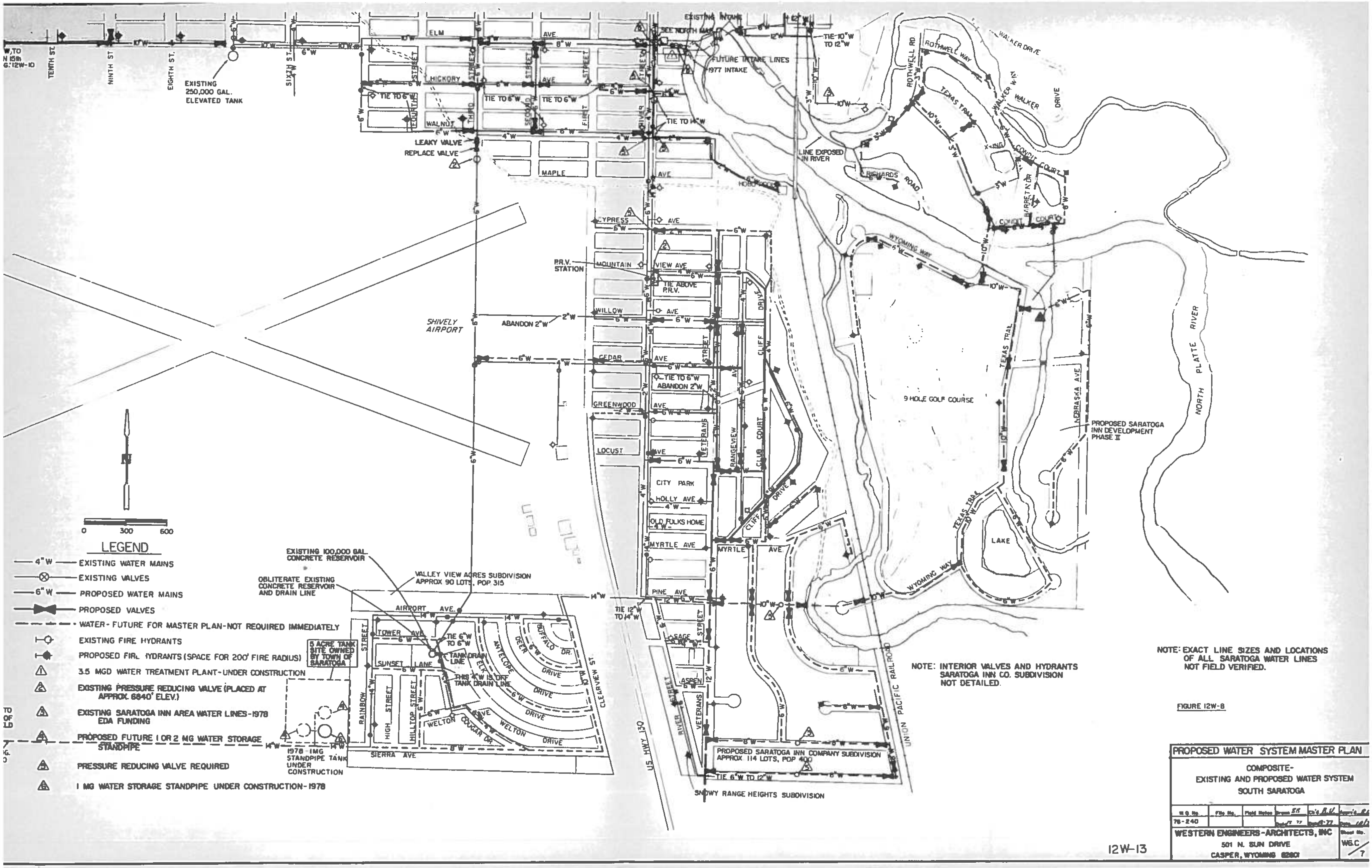
PROPOSED AND FUTURE WATER SYSTEM
SOUTH SARATOGA

W.O. No. 76-240

WESTERN ENGINEERS-ARCHITECTS, INC
501 N. SUN DRIVE
CASPER, WYOMING 82601

Sheet No. WS.P 7

12W-12



LEGEND
EXISTING WATER MAINS
EXISTING VALVES
PROPOSED WATER MAINS
PROPOSED VALVES
WATER - FUTURE FOR MASTER PLAN - NOT REQUIRED IMMEDIATELY
EXISTING FIRE HYDRANTS
PROPOSED FIRE HYDRANTS (SPACE FOR 200' FIRE RADIUS)
3.5 MGD WATER TREATMENT PLANT - UNDER CONSTRUCTION
EXISTING PRESSURE REDUCING VALVE (PLACED AT APPROX. 6840' ELEV.)
EXISTING SARATOGA INN AREA WATER LINES - 1978 EDA FUNDING
PROPOSED FUTURE 1 OR 2 MG WATER STORAGE STANDPIPE
PRESSURE REDUCING VALVE REQUIRED
1 MG WATER STORAGE STANDPIPE UNDER CONSTRUCTION - 1978
0 300 600
EXISTING 250,000 GAL. ELEVATED TANK
SHIVELY AIRPORT
EXISTING 100,000 GAL. CONCRETE RESERVOIR
OBLITERATE EXISTING CONCRETE RESERVOIR AND DRAIN LINE
VALLEY VIEW ACRES SUBDIVISION APPROX 90 LOTS, POP 315
5 ACRE TANK SITE OWNED BY TOWN OF SARATOGA
1978 - 1MG STANDPIPE TANK UNDER CONSTRUCTION
PROPOSED SARATOGA INN COMPANY SUBDIVISION APPROX 114 LOTS, POP 400
SNOWY RANGE HEIGHTS SUBDIVISION
PROPOSED SARATOGA INN DEVELOPMENT PHASE II
9 HOLE GOLF COURSE
NORTH PLATTE RIVER
UNION PACIFIC RAILROAD
US HWY 130
NOTE: INTERIOR VALVES AND HYDRANTS SARATOGA INN CO. SUBDIVISION NOT DETAILED.
NOTE: EXACT LINE SIZES AND LOCATIONS OF ALL SARATOGA WATER LINES NOT FIELD VERIFIED.
FIGURE 12W-8
PROPOSED WATER SYSTEM MASTER PLAN
COMPOSITE - EXISTING AND PROPOSED WATER SYSTEM
SOUTH SARATOGA
76-240
WESTERN ENGINEERS-ARCHITECTS, INC
501 N. SUN DRIVE
CASPER, WYOMING 82601
WE.C
7
12W-13

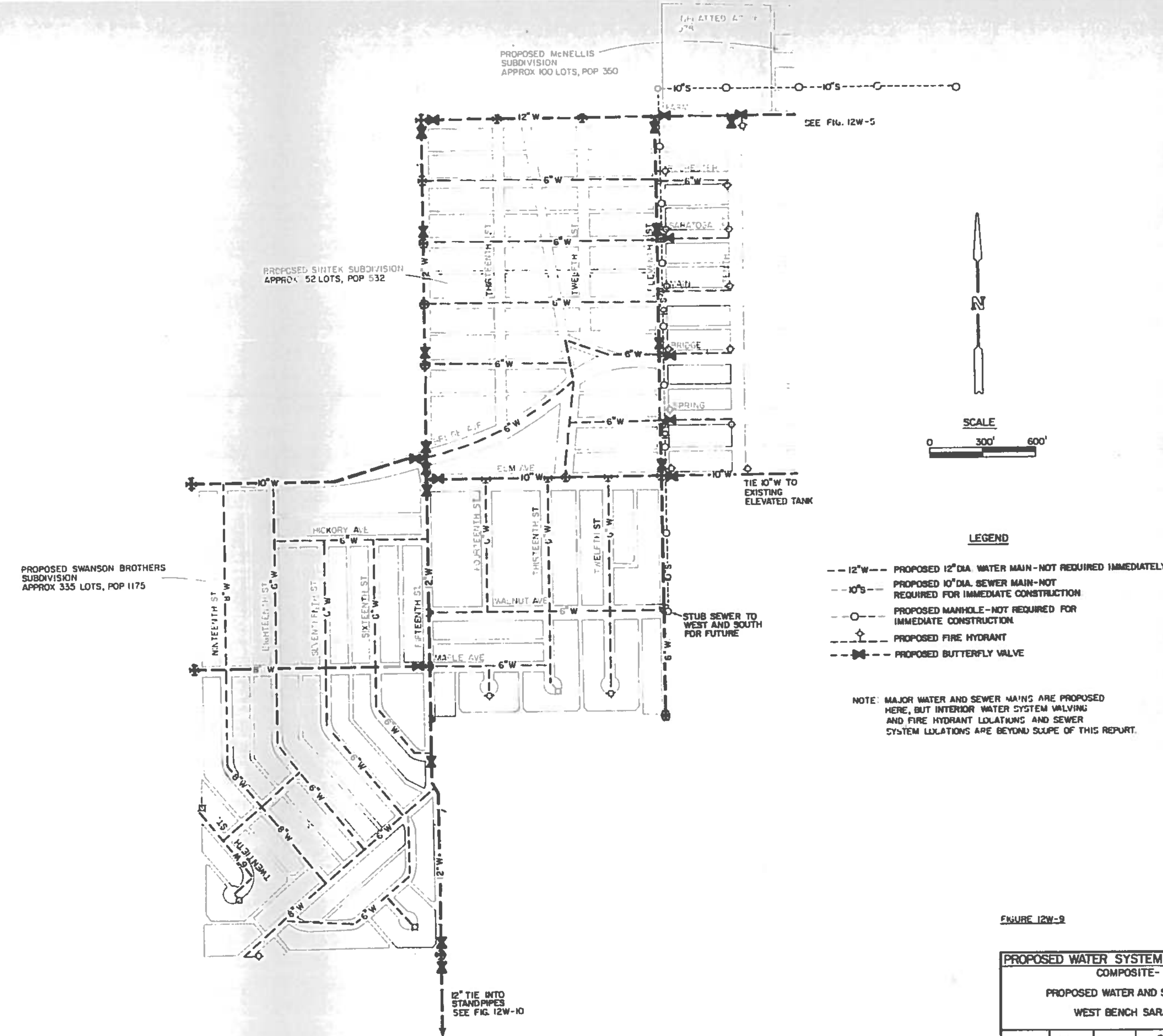


FIGURE 12W-9

PROPOSED WATER SYSTEM MASTER PLAN

COMPOSITE-

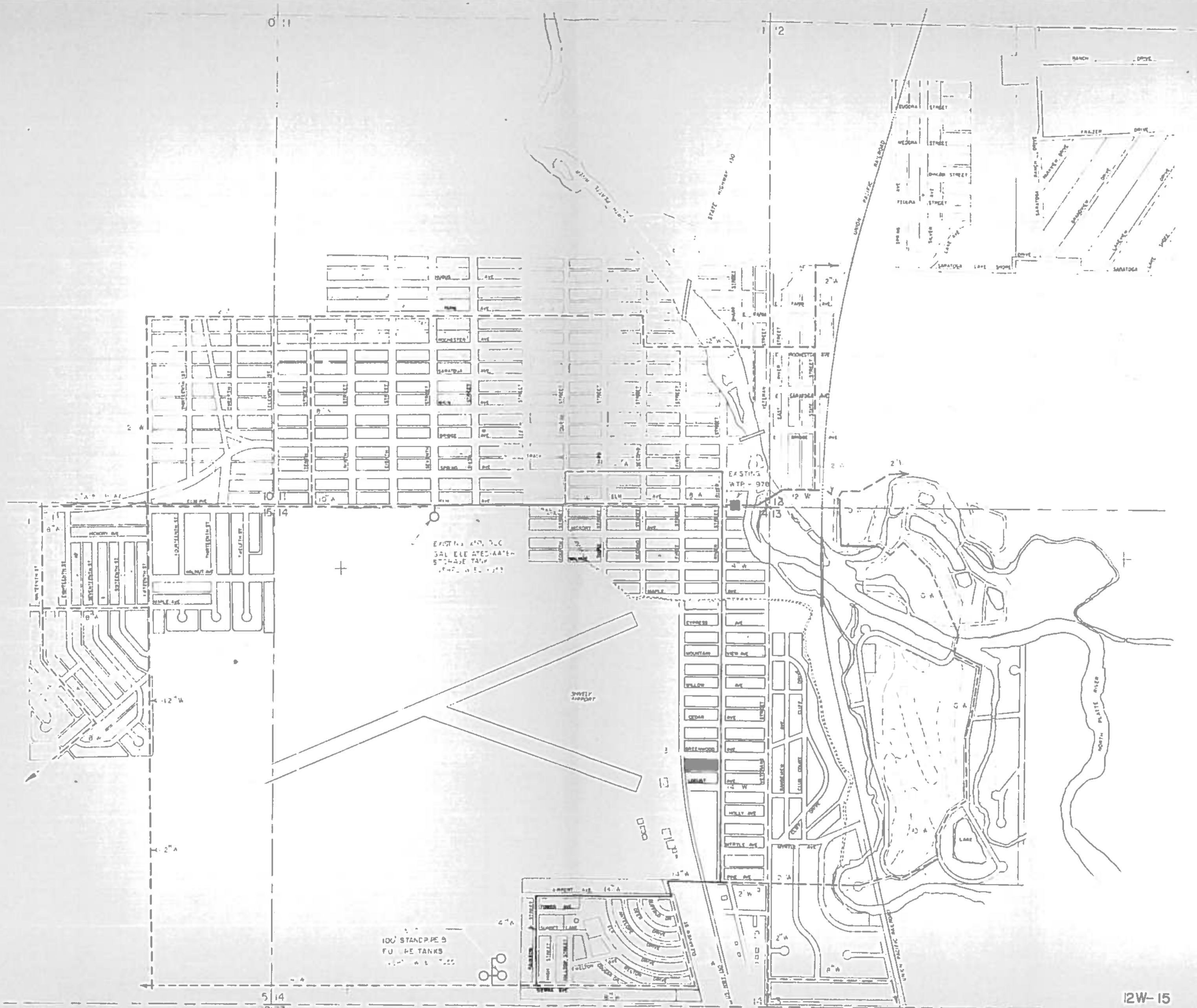
PROPOSED WATER AND SEWER SYSTEM

WEST BENCH SARATOGA

WESTERN ENGINEERS-ARCHITECTS, INC
501 N. SUN DRIVE
CASPER, WYOMING 82601

Sheet No. WBS7.C

12W-14



LEGEND

—10"W— EXISTING 10" DIA WATER MAIN

--10"W-- PROPOSED 10" DIA WATER MAIN

NOTE: ONLY MAJOR WATER LINES SHOWN. REFER TO OTHER FIGURES FOR NEEDS AND SMALLER LINES

Fig 12W-10

PROPOSED WATER SYSTEM MASTER PLAN

MAJOR PERIPHERAL WATER MAIN LOOPING PLAN

WESTERN ENGINEERS ARCHITECTS INC
CASPER WYO 82601