CHAPTER 13W. - STORAGE

The scope of this chapter is to describe and evaluate the existing water storage system, and make recommendations for improvements.

Description of the Existing Storage System

The existing storage system consists of a low level 100,000 gallon capacity concrete reservoir, and a 250,000 gallon welded steel elevated storage tank. The concrete reservoir as shown in Fig.13W.-1 was built into the side of a hill many years ago South of Town, just above the airport. The tank has a cedar shake roof, and its overflow elevation is 6953 ft.

The elevated steel tank was built in 1972 and is located on Elm St., 8 blocks West of the water treatment plant. Its overflow elevation is the same as the concrete tank, 6953 ft. The tank overflow is 113 feet above ground level. A concrete controls vault was constructed at the elevated tank with an altitude valve located on the inlet line into the tank, and a pressure transmitting devise mounted on the wall. The altitude valve is designed to be set such that when the tank is full, it closes and no more water will enter to overflow the tank. The pressure transmitting devise is designed to control the automatic operation of the high service pumps in the water treatment plant via a leased phone circuit. The transmitter for relaying tank levels back to the water plant are located on a pole at the elevated tank.

Evaluation of the Existing Storage System

The existing storage system is inadequate for the present population in Saratoga. The combined storage capacity of the two tanks is only 350,000 gallons when full. This amount is about half of the total storage required to fight a fire according to the NFBU requirements, especially considering that the water plant cannot pump the peak demand for a population of 2500.

In addition the old concrete tank is completely inadequate as a storage structure. The cedar roof is leaky, and needs major repair or replacement. Fig. 13W.-2 shows the wooden box manhole and wooden lid that exist on the tank inlet line. There is no lid on this manhole and this allows cold air to enter and the potential for freezing of the pipe exists. To prevent this, an incandescant light has been installed during the winter to keep the line from freezing. Fig. 13W.-3 shows the unsecured screen on the overflow line. This and the leaky tank roof provide easy access for insects, birds, rodents, and dirt and dust. The tank has a 2 foot high mud leg in it which keeps 2 feet of water in the tank all the time. The concrete tank is quite old and was built without quality control and would be difficult to repair.

The elevated storage tank in Town is an adequate storage structure. However, in addition to storage capacity, the system or supply pressure provided by storage structures is an important factor when determining their location and their size.

Storage tanks that gravity feed into the system should be sized and located to provide a static pressure of 45-70 p.s.i. at the highest point served by the system. This means that a tank should be located about 100 ft. above the highest service. The static pressure, i.e., when the pumps in the plant are not pumping, supplied by the existing tanks when full at the water treatment plant is (6954-6788.00) 166 ft. of water, or 72 p.s.i. This pressure decreases the higher the rise in elevation. Homes located at the base of the elevated tank will have a pressure of about 50 p.s.i. when its full. When the tanks are not full, the pressure is decreased to whatever elevation the water level has decreased to at that time. The elevation of the existing tanks now limit growth to higher elevations as proposed by many of the newer developments, as system pressures will not be adequate especially to the South and West of Town.

It is critical for the Town to increase its storage capacity, and to increase the pressure to the higher areas around Town that are supplied by the storage system. There are two ways of increasing system pressures; by building a taller tank, or building low level storage tanks with pressure booster stations to serve those higher areas where pressures are low. Pressure booster stations are relatively simple systems, however, they require operation and maintenance, in addition to the power requirements to operate them. During power failures, which may occur as a result of fire, they are useless and cannot provide fire flows and pressures should a fire occur in the higher areas which they serve. This necessitates a backup power generator with the booster station and additional operational and maintenance costs.

Recommended Construction

From the storage requirements discussed in Chapter 2W., and pressure requirements needed for new developments to the areas South and West of Town, it is our recommendation to construct a new 1.0 million gallon water storage tank. The tank should be a welded steel tank, and be painted with a 5 year paint system both inside and out to protect the steel from corrosion. In addition the tank should be provided with a freezeless cathodic type of corrosion protection system to increase the life of the paint and steel.

It is our recommendation to construct a stand pipe, i.e., the tank diameter is less than its height, 100 feet above the highest point within reasonable proximity to the Town and proposed future developments. Figure 13W.-4 shows the proposed system with the new tank. With a 100 ft. high tank, the pressure at the base of the tank will be 45 p.s.i. when full. This assures that locations below the 100 ft. tall tank will have pressures in excess of 45 p.s.i. when the tank is full.

Fig. 12W.-6 & 8 of the Proposed Water Improvements show the location of the proposed stand pipe. The elevation of the ground at this point is approximately 6960 feet, about the same height as the top of the existing storage tank system. Therefore, by building a 100 foot high tank here, the tank overflow level will be 100 feet higher than the present system, making the system a two tier system. Hydraulic studies show that a simple and functional two tier system can be obtained where the high level tank will supply only those customers in the high level zone. Yet the tank in the high level would service the low level automatically in the event of fire or other emergencies.

In addition to constructing the new storage tank, pressure reducing stations must be constructed. These stations as shown in Fig.13W.-4 must be located at predetermined locations, and at elevations to provide for water level fluctutations in the lower elevated tank, and avoid stagnation The check valves located in these pressure reducing stations will be designed to allow high pressure water to flow through them up the hill to high level storage. However, the water cannot return back down the hill through the check valve. The water must flow through the pressure reducing valve to get back down the hill. The P.R.V. will be set to open only when the water level in the elevated tank drops to a predetermined low level. This design will allow the water level to fluctuate in the existing elevated tank in providing low level service for low areas. This design prevents stagnation and the energy waste of pumping all the water to the high level, and letting it come back to low level. Without the pressure reducing stations, the only way the water level in the elevated tank could drop, is if the upper stand pipe was completely drained, and this is not desirable.

Other recommended construction is to abandon and obliterate the existing 100,000 gallon concrete water storage tank South of Town, after the new tank is put into service.

The Town should obtain land for easy access and construction of the 1 M.G. tank, for Phase I, and enough additional land to easily construct a second tank at the start of Phase II construction. 5 acres are recommended.

Features of this proposed construction are as follows:

1. As shown in Section B of the Appendix a 100 feet high 1 M.G. storage tank will allow gravity service to, and expansion of a much greater area of the Town than any low level gravity type storage system. Table 13W.-1 compares the service areas of the present low level tank system vs. a high level tank system as W.E.A.I. proposes.

TABLE 13W.-1

COMPARATIVE AREAS WITH INADEQUATE FIRE PRESSURE:
LOW LEVEL TANK VS. HIGH LEVEL TANK

CITY SIZE	EXPANSION ACRES	TOTAL ACRES	SECT	* LOW LEVEL TANK AREA W/INADEQUATE FIRE PRESSURE	LOW LEVEL TANK % of TOTAL of EXPAN.	HIGH LEVEL TANK AREA/W INADEQUATE FIRE PRESSURE	HIGH LEVEL TANK % of TOTAL
2500	640	640	1	41 A	6	0	0
5000	640	1280	2	370 A	58	40	6%
10000	1400	2680	4.19	780 A	56	160	11%
		Town Total		1191 A	44	200	7%

*INADEQUATE FIRE PRESSURE - 50 p.s.i. or less. Data drawn on basis of tanks always being 100% full which gives every advantage to low level tanks.

It is clear that a high level storage system will allow much more expansion for future growth than the present low level system.

2. A 1.0 M.G. storage tank in addition to the 0.25 M.G. already existing will provide adequate fire protection for a population of 5,000 provided that the water plant high service pumps will pump the peak day demand. With a 100 feet high tank, the system is assured of pressures for fighting the fire, even during a peak demand period.

3. By having the proposed pressure reducing stations, the additional operation and maintenance costs for a low level storage system with several booster stations will be reduced. Only that amount of water being used in the high level system will be pumped to the high level tank. The stand pipe will not be affected by power failures as would a low storage system with pressure booster pumps.

4. The 5 year paint system recommended will reduce the need for more frequent and costly repainting. The cathodic protection system will provide for protecting the steel from corrosion and thus increase the life of the paint and tank. The cathodic protection system should be freezeless to eliminate the need for removing, reinstalling and recalibrating the anodes each fall and spring before ice forms in the tank.

5. The estimated cost for constructing a 1 M.G. stand pipe 100' high is $250,000 and $350,000 for a 2 M.G. 100 ft. high stand pipe. Costs

obtained for other storage vessels during the investigation of this report are shown in Table 13W.-2.

TABLE 13W.-2

ESTIMATED 1977 CONSTRUCTION COSTS FOR STORAGE VESSELS*

Steel Ground Storage Reservoirs (20' High)

Tank Storage Capacity	Chicago Bridge & Iron Co.	Pittsburgh Des-Moines Steel Co.
.75 M.G.	$ 125,000	$ 100,000
1.0 M.G.	150,000	120,000
1.5 M.G.	190,000	160,000
2.0 M.G.	250,000	200,000

* Price includes painting, but not concrete foundation.

Elevated Steel Tank (75' to tank bottom)

Tank Storage Capacity	Chicago Bridge & Iron Co.	Pittsburgh Des-Moines Steel Co.
.75 M.G.		$ 350,000
1.0 M.G.	$ 600,000	550,000
1.5 M.G.		700,000
2.0 M.G.	1,050,000	825,000

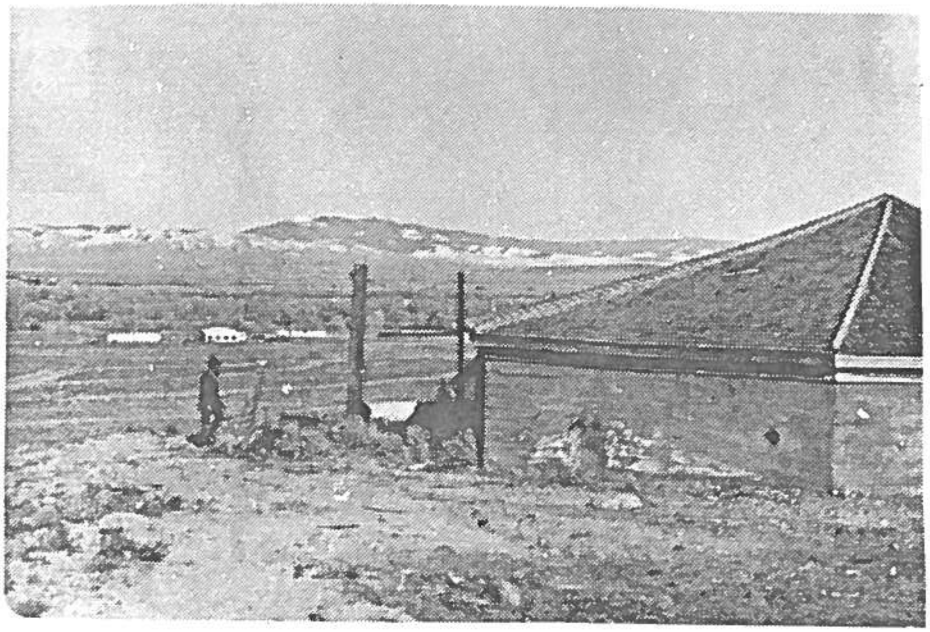


Fig. 13W-1

Existing Concrete Water Storage Reservoir Located South of Town

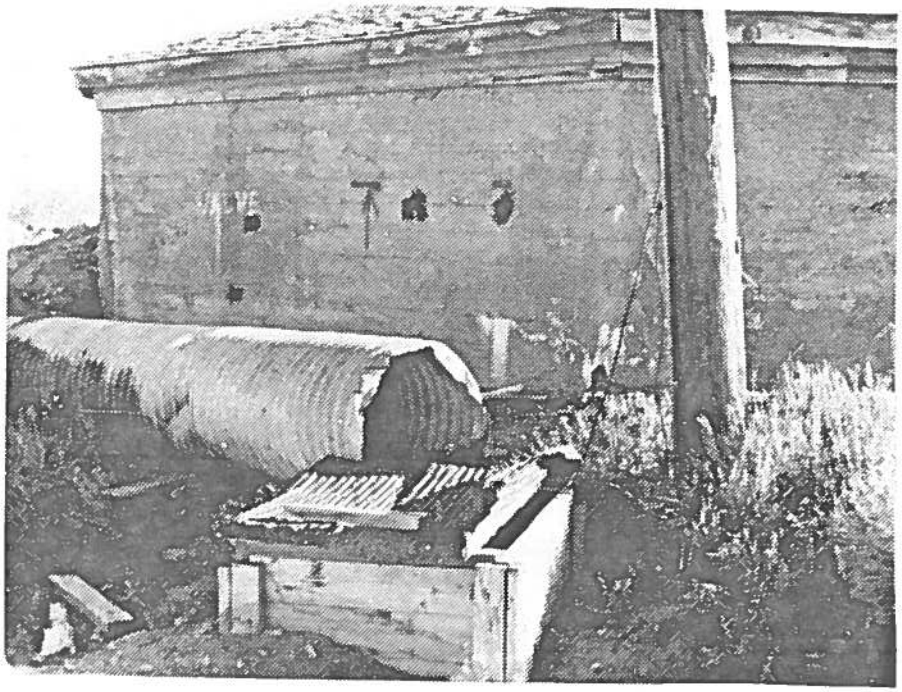


Fig. 13W-2

Controls Manhole at Concrete Reservoir So. of Town

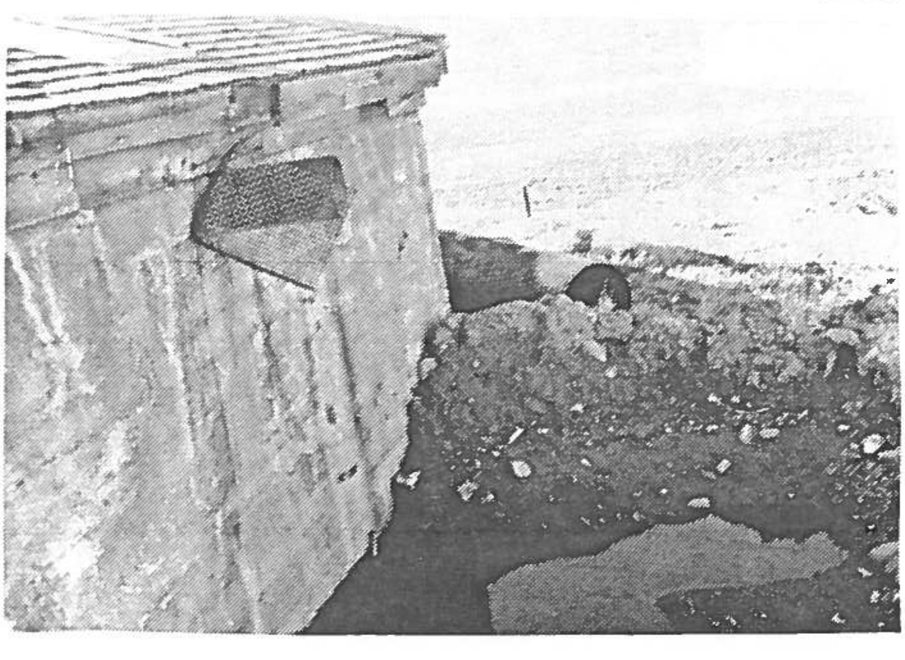


Fig. 13W-3

Unsecured Screen on Overflow Pipe at Concrete Reservoir So. of Town

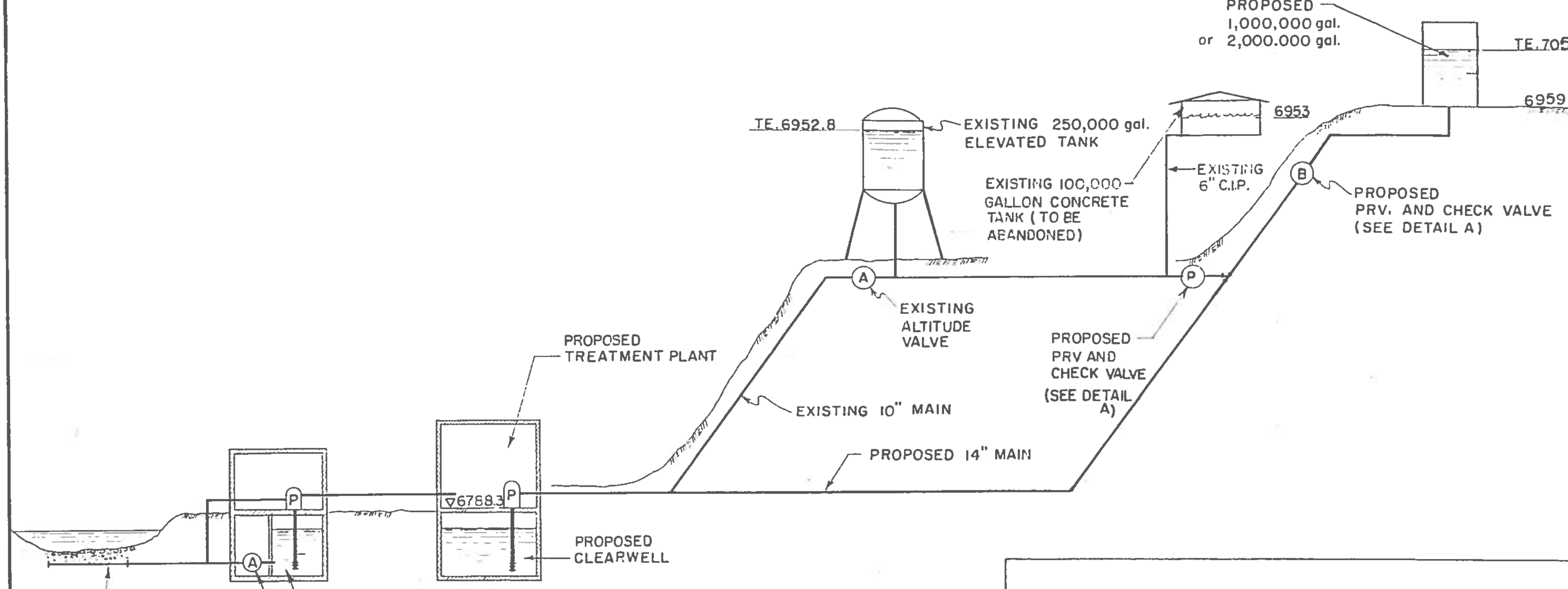
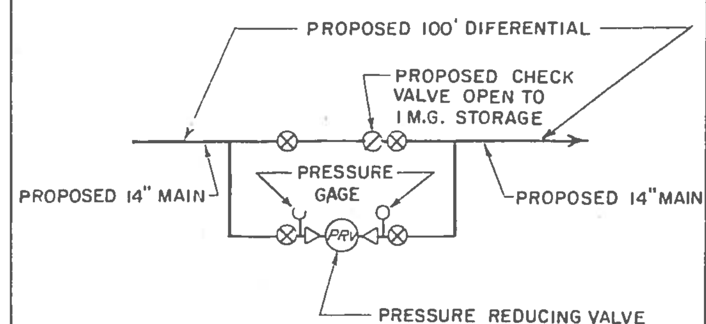


Fig. 13W-4
SARATOGA WATER SYSTEM
SCHEMATIC OF PROPOSED COLLECTION, TREATMENT,
TRANSMISSION AND STORAGE



DETAIL A

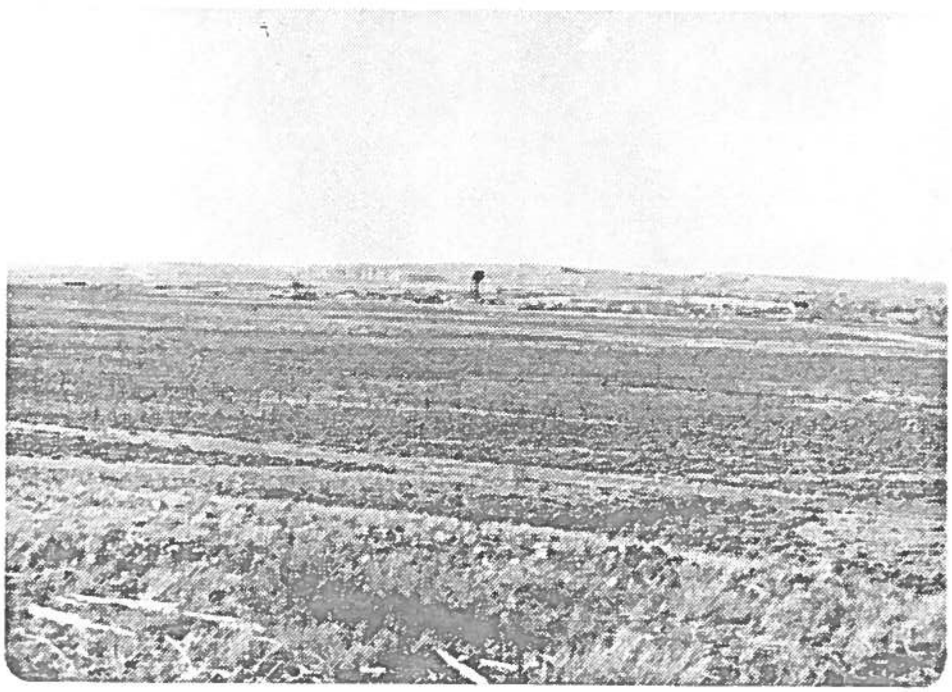


Fig. 13W-5

Existing Elevated Water Storage Tank
Located on 7th & Elm, in the distance