CHAPTER 2

ALTERNATIVES

2.1 INTRODUCTION

This chapter presents alternatives that meet the goals for the new water development project for the City of Wichita, Kansas. These goals are:

1) to determine water supply plans capable of supplying the year 2050 projected average and maximum daily demands of 112 and 223 MGD, respectively, and
2) to protect the Equus Beds aquifer's water quality.

Each alternative is discussed with regard to physical features, water supply plan components, amount of additional water supply available, implementation, operations and cost. This chapter also includes a discussion of water conservation and No-action. Alternatives were selected for further evaluation based upon engineering feasibility, economics or cost, and water quality impacts. Figure 2–1 illustrates the selection process used to determine which alternatives met the goals and would be environmentally assessed for impacts. Environmental impacts of the feasible alternatives are further discussed in Chapter 4.

Water quality was an important consideration in determining if raw water could be treated to drinking water quality with existing conventional water treatment processes.

2.2 IDENTIFICATION OF ALTERNATIVES

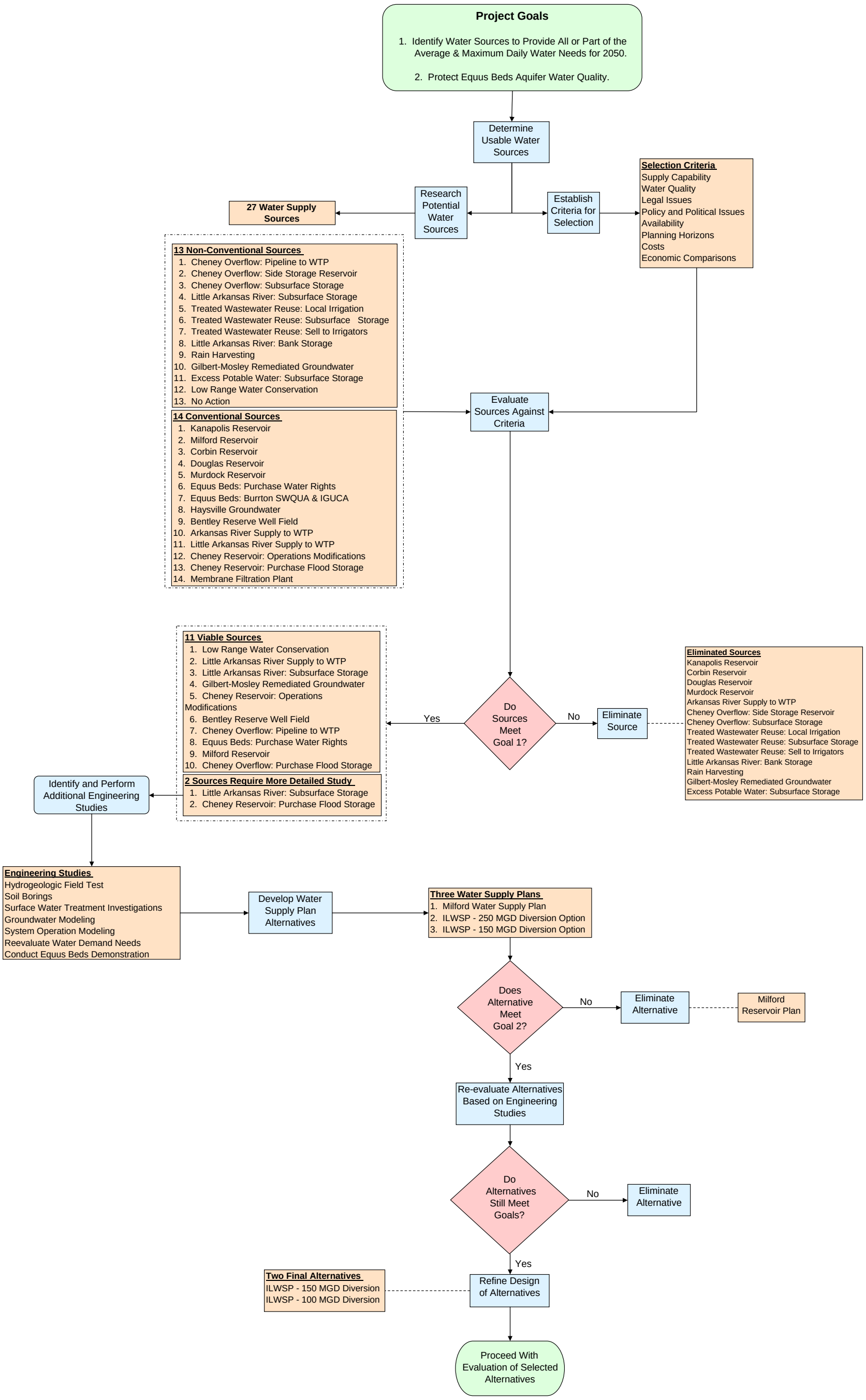
The following section discusses the selection process used to determine the alternatives to be environmentally assessed and describes these in detail.

2.2.1 ALTERNATIVES SELECTION PROCESS

In meeting the first goal for a new water development project, 27 water supply sources were identified in a study completed by the City in 1993. Each alternative or water supply source was analyzed using conceptual designs and operating protocol, estimated project construction and operation costs, and water quality parameters. Criteria were developed to screen each water supply alternative for capability, quality, future availability, legal issues, policy and political issues, planning horizons, environmental issues, and costs.

The water supply capability was indicated by the firm yield, safe peaking ability, water rights, ability to meet demands, conjunctive use and peak nonpotable use criteria. The quality of raw water determines the type and cost of water treatment. All drinking water must meet existing and pending regulations of the Safe Drinking Water Act Amendments. Water supply alternatives involving aquifer recharge may need treatment of recharge water to meet KDHE requirements. Legal issues applied to alternatives that transferred more than 2,000 acre-feet of water a distance of more than 35 miles. Policy issues considered purchase of water rights and use of right of condemnation. Future availability of the water supply is related to the ability of the City to execute the plan given a number of regulatory, social,

Figure 2-1 Alternative Selection Process



economic and political constraints. The planning horizon is to meet the water needs from 2000 to 2050. Environmental issues involved biological resources, cultural resources, relocations, land or right-of-way requirements, timber removal, wetlands, state forests and natural areas and inundation of rivers and streams. Project cost estimates and costs per unit of available flow estimates were developed for the purpose of comparing each water supply alternative to determine the most economically viable alternative(s).

The existence of major deficiencies or fatal flaws eliminated an alternative from further study. The most promising or viable alternatives were carried forward and evaluated in more detail. A brief description of criteria developed to screen each water supply alternative is presented in Appendix A.

Each water supply source must be able to operate in conjunction with existing water system components and the combined facilities must furnish the projected 2050 average day and maximum day demand to the City of Wichita's water service area. Water quality was also an important consideration in determining if the raw water could be treated to drinking water quality with existing conventional water treatment processes. Drinking water must comply with the federally mandated 1974 Safe Drinking Water Act (SDWA) and the Amendments to the act.

Project cost estimates and costs per unit of available flow estimates were acquired for the purpose of comparing each water supply source to determine the most economically viable sources. Estimates of cost per unit of available flow were based on the total project cost divided by the total available flow over a 55-year period from 1996 through 2050. The existence of major deficiencies or fatal flaw(s) eliminated a water source from further study.

The 27 water supply sources consisted of 14 conventional and 13 non-conventional sources throughout the regional area in and around Wichita. Conventional water supply sources included existing and proposed reservoirs, groundwater and surface water flow. Non-conventional water supply sources included use of reservoir overflows, above average or flood stream flow, treated wastewater reuse, groundwater bank storage[1], rain harvesting and water conservation. Of the 27 water supply sources, 11 were considered viable water supply sources and only 2 sources required further detailed study. Appendix A contains additional information on supply sources.

From the eleven viable water supply sources, three water supply plans were developed: the Milford Reservoir Plan, the Integrated Local Water Supply Plan (ILWSP) with 250 MGD Diversion Option and the ILWSP with 150 MGD Diversion Option. Both of the ILSWPs used a combination of water supply sources to meet the 2050 water needs. All three water supply plans were selected based on engineering feasibility, economics or cost, and water quality. A comparison of the three plans is provided in Appendix A.

To meet the second goal of a new water development project, the three alternatives (ILWSP 250 MGD option, ILWSP 150 MGD option, and Milford Reservoir) were evaluated for the capability to protect the Equus Beds

[1] *Bank storage* – the temporary increase in groundwater levels in the alluvial river bank during periods of high river flows.

aquifer's water quality. Under the Milford Reservoir alternative, no protection would be provided to the aquifer; the City would continue to withdraw water from the aquifer with continued use by local irrigators and only a natural recharge would occur. This natural recharge is insufficient to maintain a safe water quality level within the aquifer and prevent inflow of natural and manmade high chloride water in the well field area.

Both of the ILWSP options include a component to recharge the aquifer. Further engineering studies were required to determine the best method for recharge. Therefore, the City designed and implemented a recharge demonstration project, from 1994 to 2000, to determine:

- if overall groundwater quality would be acceptable
- economic validity of operation and maintenance requirements
- validity and potential problems associated with long-term recharge operations
- full-scale design criteria

Results of the demonstration project proved the capability of the ILWSP options to meet the second goal of protecting the Equus Beds aquifer. Further hydrologic investigations revealed that the amount of recharge needed to maintain a safe water level within the aquifer was lower than originally estimated; therefore, several options were reviewed with regard to the recharge component in the ILWSPs.

Thus only two alternatives remained to be analyzed for this project—the ILWSP 250 MGD and the ILWSP 150 MGD. Refinement of these two alternatives resulted from information learned from the demonstration project and various engineering studies. These studies included a re-evaluation of the water demand needs for Wichita, hydrogeologic field tests, soil borings, groundwater modeling, system operation modeling, and surface water treatment investigations. Based on the modifications to the plans, they were renamed ILWSP 150 MGD Diversion and ILWSP 100 MGD Diversion. The following section gives the details of these two plans.

2.3 ALTERNATIVES CONSIDERED IN DETAIL

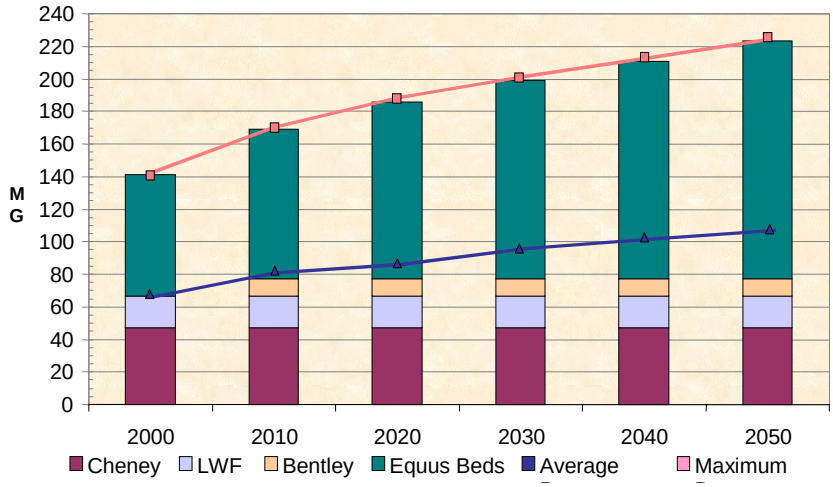
The basic strategy of the ILWSPs is to shift the priority of use and primary makeup of the City's raw water supply from groundwater to surface water when it is available. This allows water to be conserved in the aquifer both for growing water demands and water needs during extended dry weather conditions. Both ILWSP alternatives contain the same components; however, the Equus Beds recharge and the Local (E&S) Well Field (LWF) components include several options. The ILWSPs components are:

1. **Water Conservation** - rates and pubic education to influence water demands by all customer classes.
2. **Bentley Reserve Well Field** – redevelopment of an existing well field along the Arkansas River for use in meeting short-term peak water demands.
3. **LWF Expansion** - to more effectively use "above-base" flow water from the Little Arkansas River and "leakage"

water[2] from the upstream, recharged Equus Beds aquifer.

4. **Cheney Reservoir** - greater use of spillage[3] and flood storage water
5. **Equus Beds Aquifer**
   - continued use of the city's existing rights to pump water from the Equus Beds aquifer
   - capture of "above-base" flow water from the Little Arkansas River to be used for recharge of the Equus Beds aquifer or direct supply to water treatment facilities in the City
   - recovery of stored water in the Equus Beds aquifer during extended dry weather conditions for conveyance to the City's water treatment plants

Figure 2-2 Projected Average and Maximum Day Demand & Available Component Water Supply



Projections of the average and maximum day water demand and available component water supply are shown in Figure 2–2. Review of this figure shows current and future supply capacities for each water source. Year 2010 represents the short-term future by which time major facilities of the plan would be operational. Year 2050 represents the long-term future at the end of the planning period. The ILWSPs are based on an optimized priority of water use on an "as available" basis from several sources to meet demand from storage during dry periods. The priority of use and maximum capacities for various water supply sources operated by the City, as envisioned in the ILWSPs, are shown in Table 2–1.

The physical features of each of the alternatives, including the amount of water supplied, plan components, implementation, and costs are discussed below. A summary of environmental impacts for each viable water supply alternative is presented at the end of the chapter.

2.3.1 WATER CONSERVATION COMPONENT

Water conservation is achieved through the continuous use of various management and technological activities, public awareness and education programs, and enforcement efforts. A thorough water conservation program encourages more effective use of water resources and the most efficient use of water by consumers. Conservation activities associated with the two water

[2] *Leakage water* – is stored water that has migrated from the Equus Beds aquifer and re-entered the Little Arkansas River due to the natural gradient of the groundwater system.
[3] *Spillage* – water that overflows into the spillway of a dam.

Table 2-1 Allocation Order of Plan Components

Allocation Order	Source	Maximum Supply Rate (MGD)	Remarks
1	LWF Expansion	45	Used only when water flow in Little Arkansas River exceeds assumed minimum flow requirements.
2	Equus Beds Aquifer -Little Arkansas River	60	Availability depends on river flow and minimum desirable stream flow requirement. This direct surface water diversion from the Little Arkansas River to the water treatment plant is **not** included in all development alternatives.
3	Cheney Reservoir	80 47 See Note (1)	If pool level is at or above 1,422 feet If pool level in the range 1,417 – 1,422 feet If pool level below 1,417
4	LWF	30	Availability depends on water flow in the Arkansas River at Wichita. Withdrawals are limited at lower river flows for water quality reasons. Withdrawals limited to 5 MGD when river flow is less than 500 cfs and 10 MGD when flow is less than 1,500 cfs.
5	Bentley Reserve/Equus Beds Well Fields	43.2	Mix of one part Bentley Reserve Well Field water (up to 10.8 MGD) and three parts Equus Beds water (up to 32.4 MGD).
6	Equus Beds Well Field	146	If Cheney Reservoir is above elevation 1,417 feet, use only as source of last resort unless Equus Beds are full. If Cheney Reservoir is below 1,417 feet, use in combination with Cheney Reservoir to balance drawdowns in both sources. Withdrawal rate limited to 78 MGD unless City has recharge credits.
7	Cheney Reservoir	47	If Cheney Reservoir level is below 1,417 feet, use in combination with Equus Beds to balance drawdowns as described above.

Notes: (1) Refer to numbers 6 and 7 in allocation order.

supply plans would involve the following:

- Review and modification of the inverted water rate structure on an annual basis to help achieve and maintain conservation goals
- Maintenance of watering restrictions (twice per week by address) during drought periods
- Encouragement of domestic consumers to use flow-restricting faucets and showerheads, reduce toilet tank capacity, and restrict lawn watering or car washing activities
- Continuation of public awareness and education programs
- Continuation of leak detection surveys to reduce water distribution system losses
- Continuation of meter repair and replacement programs to increase the accuracy of water quantity monitoring. All meters would be tested, repaired or replaced on an eight-year cycle
- Continuation of cooperative efforts with industries to encourage conservation of cooling, process and irrigation water
- Operation of surface water and groundwater supplies to minimize water losses or yield reductions. Groundwater supplies would be managed to reduce aquifer declines

and deterioration due to over-pumping

- Continue operating water treatment facilities to minimize water losses through recycling of water used to clean filters in water treatment processes

Water conservation would occur without specific programs because of federal regulations concerning water pollution control. These programs, which may require industrial wastewater pretreatment before discharge to the municipal sewer system, would promote industrial water recycling, treatment, and reuse because of economic conditions which influence the relative cost of water and wastewater treatment.

Ten Ways to Conserve

1. Avoid Over-Watering Plants and Lawns.
Apply water at a rate that matches soil absorption.

2. For Best Results Try Morning Watering.
Evaporation loss is at a minimum.

3. Avoid Washing Down Paved Areas.
Sweep driveway and sidewalks in garden cleanup.

4. When Washing the Car...
Use a bucket for water. Hose off only to rinse.

5. Repair Faucet Leaks.
As much as 15 gallons of water can be lost each day with a slow drip.

6. Avoid Toilet Water Waste.
Do not use toilet as a trash disposal.

7. Reduce Shower time.
An extra five minutes in the shower could mean another 50 gallons down the drain.

8. Use the Automatic Dishwasher Wisely.
Half-loads cheat you out of full-water use.

9. Watch Those Laundry Loads, Too.
Some 50 gallons of water are used to wash a load of clothes. Make every load count.

10. Avoid Running the Faucet.
Don't run water continuously while shaving, brushing teeth, peeling vegetables, or washing dishes.

Source: California Water Service Group

2.3.2 REDEVELOPMENT OF THE BENTLEY RESERVE FIELD COMPONENT

The Bentley Reserve Well Field is located adjacent to the Arkansas River, south of the town of Bentley and along the right-of-way for the 66-inch well field pipeline (Figure 1–3). The original wells have been abandoned and the water rights have been terminated. Redevelopment of the abandoned Bentley Reserve Well Field could supply up to 10 MGD of relatively high chloride water to meet peak demands. The high chloride water would be blended with water from other sources to maintain a level less than 200 mg/l to meet short-term peak water demands during dry weather conditions.

2.3.2.1 Implementation

Redevelopment of the abandoned Bentley Reserve Well Field would start design and construction in 2004 and end in 2005. Field studies and permitting would take place prior to the design and would start in 2003.

2.3.2.2 Costs

The estimated cost for the vertical wells in the redevelopment of the Bentley Reserve Well Field is $1,250,000. Annual operating and maintenance costs are estimated at $26,000.

2.3.3 LOCAL WELL FIELD COMPONENT

The LWF lies downstream of the Equus Beds Well Field at the confluence of the Arkansas and Little Arkansas rivers, near the City's Central Water Treatment Plant. Currently, the LWF is used only during periods of peak demand.

The existing LWF is comprised of 17 wells constructed between 1949 and 1953, plus three redrilled wells constructed in 1997.

The expanded LWF, which incorporates the City's original E & S Well Field, is expected to supply up to 39 percent of the City's raw water needs.

Expansion of the LWF would use "above base flow"[4] water from the Little Arkansas River. In addition, any "leakage water" from the Equus Beds aquifer would also be collected by the new system. Water from both sources would be transferred directly to the Water Treatment Plant. New components would include:

- Four horizontal collector wells with pump houses
- Five vertical wells with pumps and motors (underground discharge configuration)
- Collecting pipelines (with easements)

Expansion of the LWF along the Little Arkansas River and Floodway is expected to improve water quality and provide higher production rates.

The conceptual design for the collector wells is 10 MGD for high river stage conditions (2 feet above average flow). On average, approximately 25,000 acre-feet per year would be available, assuming that water can be diverted to the 20 cfs minimum desirable streamflow (MDS) limit. Actual yield would depend on how close to the river the wells can be constructed.

Water rights for the existing wells allow an average day withdrawal rate of 5.4 MGD and a maximum day withdrawal rate of 37.1 MGD. Based on 79 years of historical flow data, approximately 27 MGD would be diverted from the Little Arkansas River about 50 percent of the time and 37 MGD would be diverted about 40 percent of the time. Although the proposed expansion does not provide a firm water supply, it has the potential to divert up to 37 MGD from the Little Arkansas when it is available, saving the stored water for times of low river flow.

High chloride levels in the Arkansas River influence groundwater quality in the LWF area. Here, groundwater flows away from the Arkansas River southeast toward the Little Arkansas River. Water obtained from the existing LWF typically has high calcium hardness and relatively high chloride levels, and is therefore used primarily during peak water demand periods. Expansion of the LWF along the Little Arkansas River and floodway is expected to improve water quality and provide higher production rates with less chloride loading. Proposed expansion sites maximize infiltration of better quality water from the Little Arkansas River. Wells would be located in northwest

[4] *Above base flow* – the volume of flow in the river, which is generated from rainfall runoff that is above the base river flow as established by the State or local regulatory agencies.

Wichita, along and above the confluence of the Arkansas and Little Arkansas rivers and along the Little Arkansas floodway (Figure 2–3). Well location and spacing were adjusted based on modeling results to prevent over-pumping, which can result in excessive drawdown. Pumping rates would be controlled to reduce potential for high-salt migration towards the well field from the Arkansas River.

Piping for the upper section of the LWF is common for both options and includes connections to three horizontal collector wells. These wells pump the diverted water into a dedicated pipeline routed through the floodway, which connects to an existing 48-inch raw water line for conveyance to the Central Water Treatment Plant (Figure 2–3).

Two options exist for the Lower Section of the LWF. Option 1 conveys diverted water from the wells south to Vertical Well 5 in the Central Riverside Park area. The final section of waterline to the Central Water Treatment Plant is routed through city property and is about 4,000 linear feet longer than the final pipeline section in Option 2 (Figure 2–4).

Option 2 conveys water to Vertical Well 3 near the northern boundary of Oak Park. The final section of waterline connects the lower section of the well field from Vertical Well 3 to the existing 48-inch raw waterline for conveyance to the Central Water Treatment Plant (Figure 2–4).

2.3.3.1 LWF Implementation

The proposed layout of the LWF Expansion allows for phased construction of both vertical and horizontal collector wells and makes use of the existing 48-inch pipeline. Phase 1 of the project involves construction of a scale-up facility to initiate state permitting activities and to obtain operational data for the final design. Phase 2 consists of the full-scale project design and construction based on the results of the prototype.

Installation of the Phase 1 project and LWF Expansion will be coordinated with other improvements planned in the Equus Beds Well Field. Figure 2–5 provides an implementation schedule for the LWF Expansion including the prototype (Phase 1) and the full-scale project design and construction (Phase 2).

2.3.3.2 LWF Costs

Estimated costs for the proposed expansion range from $13.5 million to $14.3 million, based on July 1999 dollars (Table 2–2). Project costs include construction costs, a contingency allowance[5] and other costs for engineering and special services. Costs for Options 1 and 2 for the well field diversions were identified.

Table 2-2 LWF Project Cost Summary

	Option 1	Option 2
Upper Section Pipeline	$2,103,000	$2,103,000
Lower Section Pipeline	$3,076,000	$2,443,000
Horizontal Collector Wells	$5,431,000	$5,431,000
Vertical Wells	$680,000	$680,000
Land	$44,000	$44,000
15% Contingency	$1,700,000	$1,605,000
10% Other costs	$1,303,000	$1,231,000
Total	$14,338,000	$13,537,000

Note: Other costs include fees and expenses associated with technical, professional and special services.

[5] *Contingency allowance* – a percent dollar amount added to all costs to account for unknown and unaccounted-for items.

Figure 2-3 Piping Option 1 Local Well Field Expansion

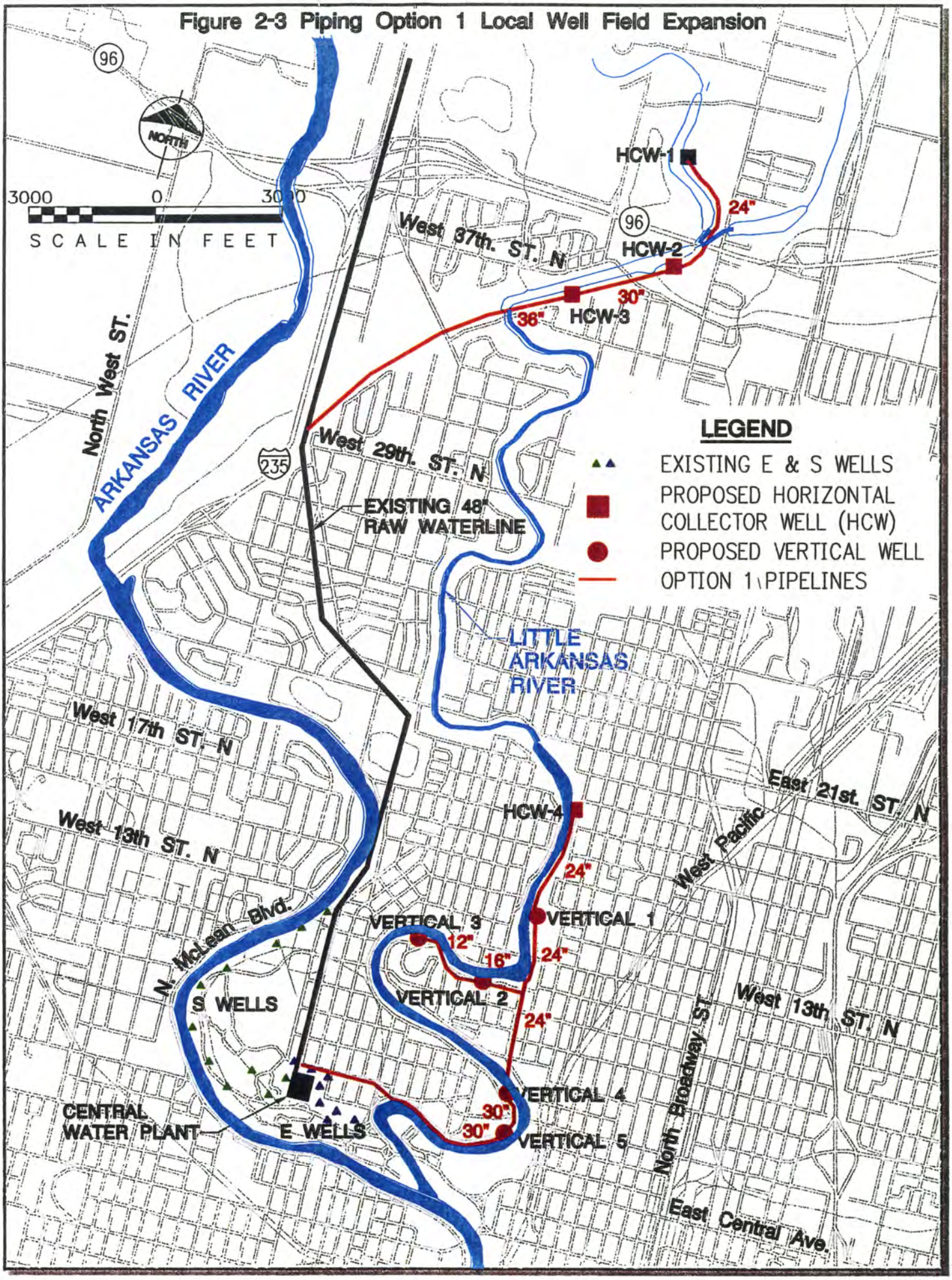


Figure 2-4 Piping Option 2 Local Well Field Expansion

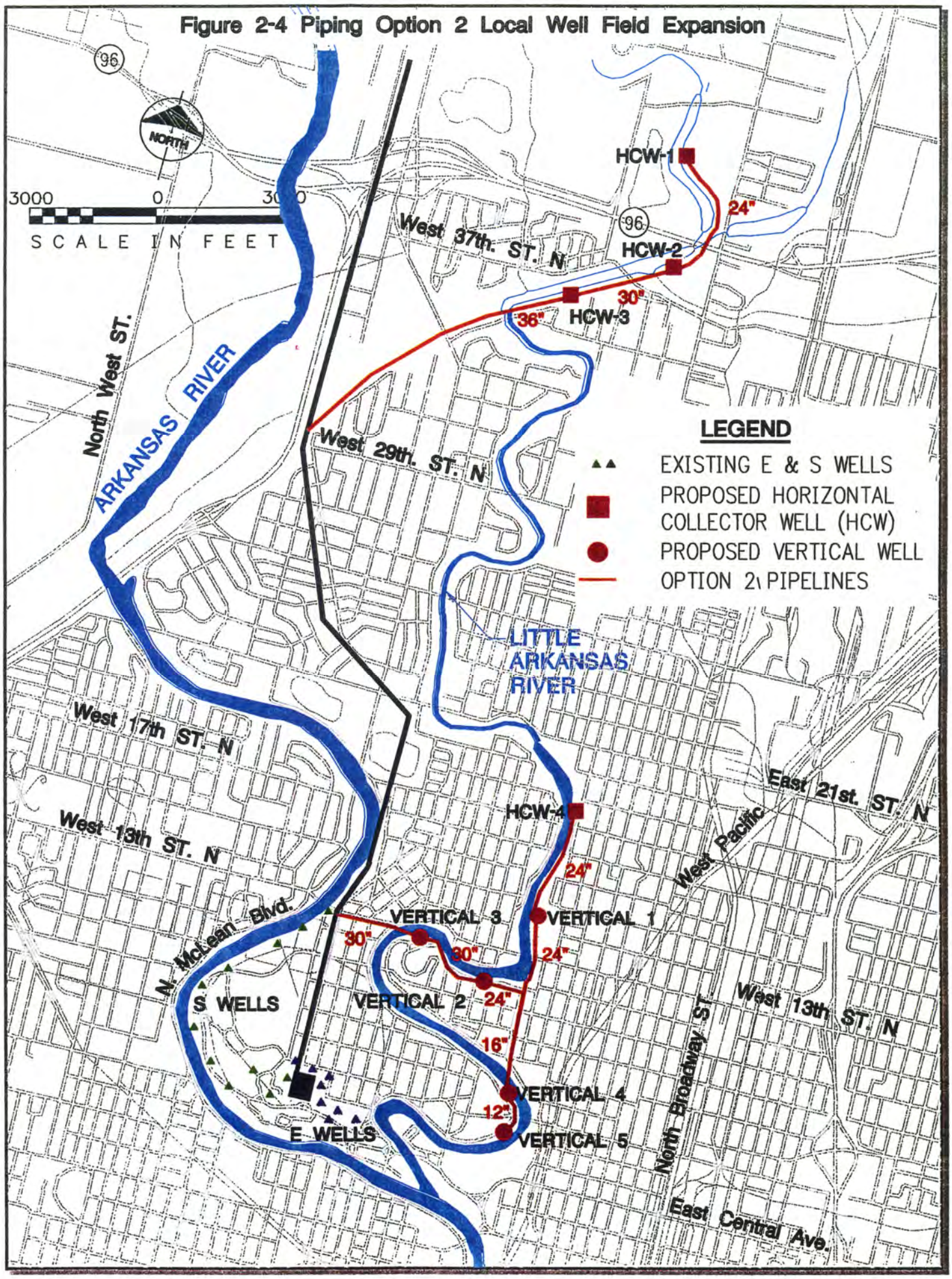
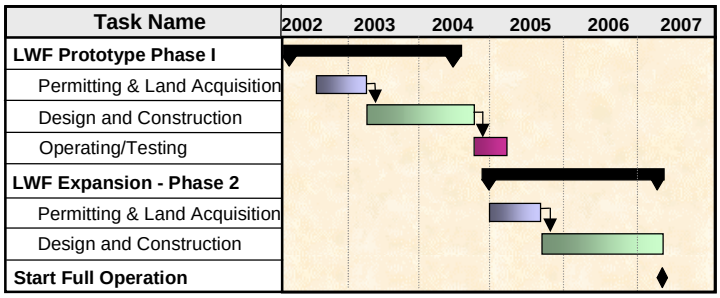


Figure 2-5 LWF Implementation Schedule



Piping for the upper section of the well field is common for both options and includes connections to three horizontal collector wells. Piping for the lower section of the LWF, which conveys water from five vertical wells and one horizontal collector well, differs for Options 1 and 2; Option 1 requires a pipeline about 4,000 linear feet longer than that of Option 2. The main transmission pipeline for the collector wells and vertical wells includes the existing 48-inch well field pipeline with improvements. Project cost figures do not include the improvements to the 48-inch pipeline, which is considered to be a separate pipe rehabilitation project.

2.3.4 CHENEY RESERVOIR COMPONENT

Use of this existing surface water reservoir will continue with only administrative or procedural changes or modifications of facility capacities. With the new conjunctive use water right permit and larger capacity water withdrawal facilities at the dam in place, the City would be able to withdraw up to 80 MGD from the reservoir when there is water stored in the flood control pool (between elevations 1,421.6 and 1,429.0 feet). At pool elevations below 1,421.6 feet, the maximum withdrawal rate from the reservoir will revert to its current limit of 47 MGD.

These changes in operating criteria will permit the City to capture more of the water in the flood control pool of the reservoir that would otherwise be released downstream by the U.S. Army Corps of Engineers (Corps) as the flood control pool is evacuated. Use of this surface water from Cheney Reservoir when it is available will allow the City to reduce withdrawals from the Equus Beds aquifer, therefore maximizing the amount of aquifer recharge that may be occurring at the time. This additional amount of aquifer recharge water will then be available for use during drier or drought conditions when water levels in Cheney Reservoir are lower and surface water inflow to the reservoir is low. The use of water from these two water sources in a balanced manner will minimize the need for the City to acquire and develop additional water supply sources from outside the local area to meet projected water demands.

The City's conjunctive use permit and the increased pumping capacity on the Cheney pipeline have increased the City's legal and physical capability to deliver water from Cheney Reservoir on both a daily and annual basis.

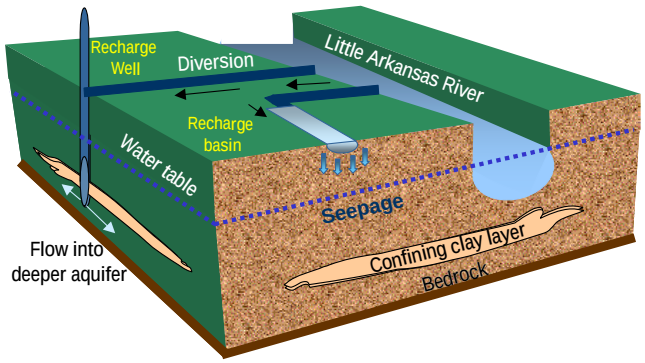
Should the City’s need for more water arise at a time that water is available in the reservoir’s flood storage pool, the capability would exist to pump water to the City’s Central Water Treatment Plant. When water levels in the flood storage pool drop to a predetermined low level, the Equus Beds aquifer (water from the existing permit or recovered recharge water) would be used. The objective is to maximize the use of storage in Cheney Reservoir, and to maximize the opportunities to recharge water into the

aquifer, with use of water from the aquifer minimized except in drought conditions. Use of these waters "as-available" allows the Equus Beds aquifer to be recharged for later use during drought conditions and minimizes the need for additional water supply sources from outside the region.

After a flood event has occurred, the amount of water the City would be able to capture from the flood control pool before it is released will depend primarily on how long this water is retained or remains in the flood control pool. The faster this water is evacuated, the less time the City would have to withdraw water from the flood control pool; therefore, the less benefit this water would have to the City from a water supply perspective.

2.3.5 EQUUS BEDS AQUIFER RECHARGE, STORAGE AND RECOVERY COMPONENT (ASR)

Two alternatives were investigated for the Equus Beds Recharge, Storage, and Recovery Project. Alternative 1 includes three options for capturing, pre-treating, and recharging 150 MGD of ground and surface water with an additional option to capture, pre-treat, and transfer 60 MGD of surface water direct to the City's water treatment facilities. Alternative 2 also has three options which would capture, pre-treat, and recharge approximately 100 MGD of ground and surface water with an option to capture, pre-treat, and transfer 60 MGD of surface water directly to the City's water treatment facilities.



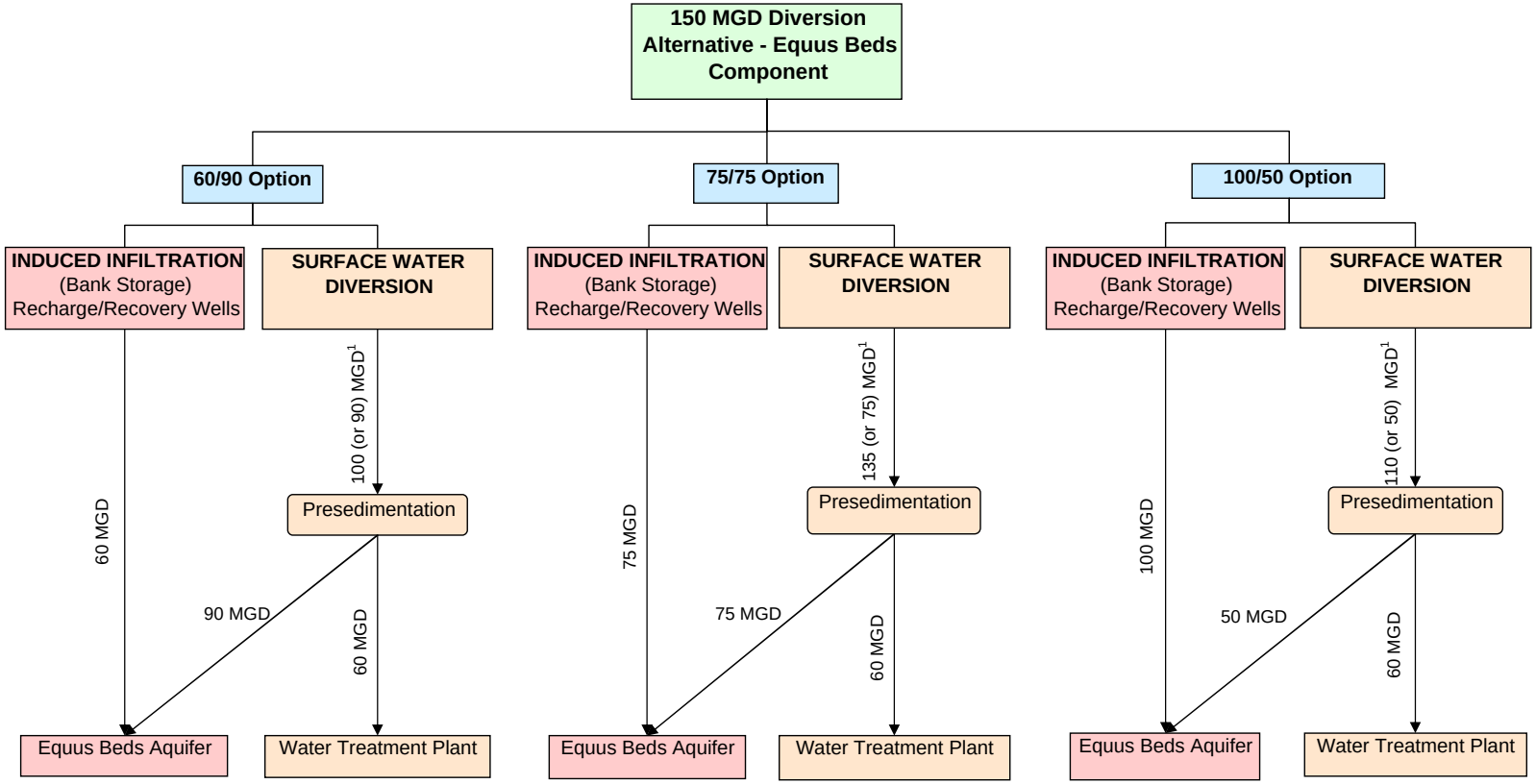
Schematic of Recharge Process

2.3.5.1 Alternative 1 – 150 MGD ASR

This component consists of three options for capturing 150 MGD of surface water from the Little Arkansas River and groundwater from bank storage adjacent to the river. This includes a surface water intake, induced infiltration wells, facilities to transfer and recharge the captured water to the Equus Beds aquifer, and to recover the stored water. A pre-sedimentation plant is proposed to treat surface water before recharging into the aquifer or piping to the City's water treatment plants. Each of the three options is considered with and without diverting 60 MGD of treated surface water to the City treatment facilities. Figure 2–6 illustrates each of the three options, which are:

- 60/90 ASR Option: Capture of 60 MGD of induced infiltration water for recharge and 90 MGD of surface water for treatment and recharge with an additional option to capture, pre-treat and convey 60 MGD of surface water direct to the City's water treatment facilities.
- 75/75 ASR Option: Capture of 75 MGD of induced infiltration water for recharge and 75 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD of surface water direct to the City's water treatment facility.

Figure 2-6 150 MGD ASR Alternative Options



1. Each of the three options is considered with and without 60 MGD of treated surface water to be conveyed to the City treatment facilities. Therefore, the amount diverted increases when 60 MGD is conveyed to the City.

- 100/50 ASR Option: Capture of 100 MGD of induced infiltration water for recharge and 50 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD of surface water direct to the City's water treatment facilities.

2.3.5.1.1 60/90 ASR Option

This option would capture 60 MGD of induced infiltration water and 90 MGD of surface water from the Little Arkansas River during above base flow conditions. All of the water removed with the induced infiltration wells would be directly recharged into the Equus Beds aquifer while the captured surface water would be treated for recharge into the aquifer. An additional 60 MGD of surface water, if designed, could be diverted from the Little Arkansas River, pretreated through a new pre-sedimentation plant and conveyed to the City's water treatment facility.

Example of Intake Structure on the Little Arkansas River

With the 60/90 ASR Option, 42 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. These wells would be divided into two groups of 21 wells with each well field requiring 4.2 miles of transmission pipeline. Other facilities necessary for the operation of the well and pipeline system would include a gravel access road, located immediately adjacent to the riparian vegetation in agricultural fields. "Bank storage" water captured from these wells would be moved via 42 miles of pipeline to 15 recharge wells at existing well sites, 18 new recharge well sites, and 4 recharge basins in the Equus Beds Well Field at existing water supply well sites.

A new surface water intake on the Little Arkansas River near Sedgwick, Kansas would have a maximum capacity of up to 150 MGD and would remove 90 MGD of surface water during above base flow periods. Approximately 2 miles of pipeline would transfer this untreated surface water to a new pre-sedimentation plant; another 12.5 miles of pipeline would transfer the treated water to 28 new recharge basins, 8 basins located at existing well sites, in the Equus Beds Well Field. If implemented, an additional 60 MGD of surface water would pass through the pre-sedimentation plant, and would be piped directly to the City of Wichita's water treatment plants for further treatment and distribution.

Also required are overhead power lines and SCADA[6] system, including a radio/ antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 75 miles of fiber optic cable along new and existing pipeline

[6] *SCADA system* – Supervisory Control and Data Acquisition system

alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plan in Wichita.

The addition of 30 recovery wells would be required to meet the projected year 2050 maximum worst dry case condition. These recovery and recharge wells would be installed between 2010 and 2050 and require additional SCADA radio/antenna equipment, 5 miles of fiber optic cable and 3 miles of transmission piping.

Figure 2–7 illustrates the general layout of the project option and implementation of the construction.

2.3.5.1.2 75/75 ASR Option

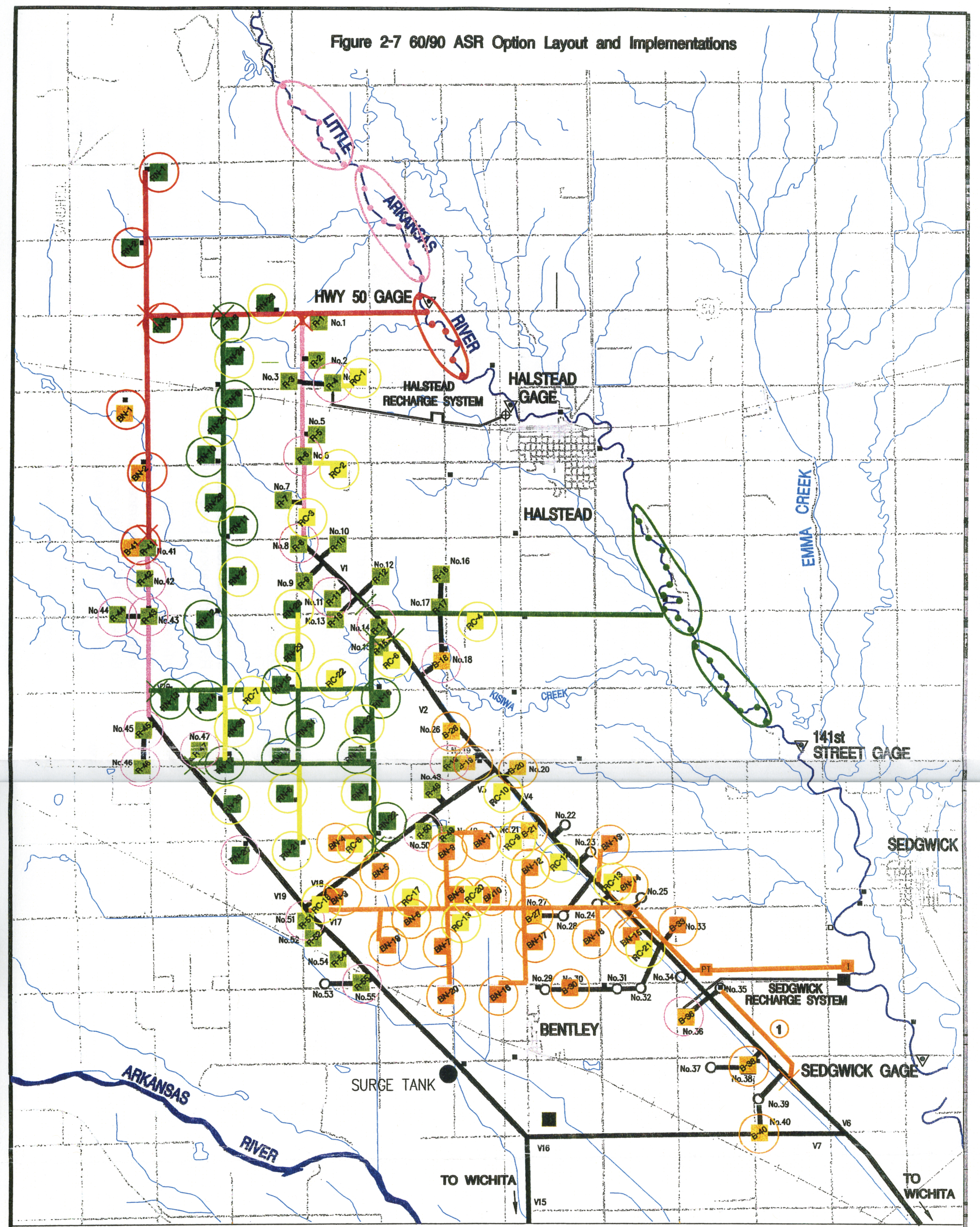
This option would capture 75 MGD of induced infiltration water and 75 MGD of surface water from the Little Arkansas River during above base flow conditions. All of the water removed with the induced infiltration wells would be used to recharge the Equus Beds aquifer while the surface water would be pretreated before being recharged into the aquifer.

Example of Recharge basin

An additional 60 MGD of surface water, if necessary, would be diverted from the Little Arkansas River, treated in a new pre-sedimentation plant and conveyed to the City's water treatment facility.

With the 75/75 ASR Option, 53 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. The 53 induced infiltration wells would be divided into two groups of 28 and 25 wells with each well field using 5.6 and 5.0 miles of transmission pipeline, respectively. Other facilities necessary for the operation of the well and pipeline system would also be immediately adjacent to the riparian vegetation in agricultural fields, including a gravel access road immediately adjacent to the wells and pipelines. The bank storage water captured from the wells would be moved via 34 miles of pipeline to 15 recharge wells at existing City of Wichita well sites, 28 new recharge well sites, and 4 recharge basins at existing supply well sites.

A new surface water intake near Sedgwick, Kansas would directly remove 75 MGD of water from the Little Arkansas River. Approximately 2 miles of pipeline would transfer this untreated surface water to a proposed pre-sedimentation plant; another 9.5 miles of pipeline would transfer 75 MGD of treated water to 22 new recharge basins in the Equus Beds Well Field. If implemented, an additional 60 MGD of surface water from the Little Arkansas River could pass through 2 miles of pipe to the pre-sedimentation plant. This pretreated water would be conveyed through 2 miles of transmission pipe to the south side of the existing well field for



LEGEND

- RECHARGE WELL SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- RECHARGE WELL SITE AT NEW SITE
- RECOVERY WELL SITE AT NEW SITE
- 2-ACRE RECHARGE BASIN SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- 2-ACRE RECHARGE BASIN AT NEW SITE
- 3-ACRE RECHARGE BASIN SITE AT NEW SITE
- PROPOSED DIVERSION WELL SITE
- PROPOSED PRESEDIMENTATION TREATMENT PLANT
- PROPOSED SURFACE WATER INTAKE
- 60 MGD SUPPLY OPTION TO CITY'S WATER PLANT
- PHASE I – PROTOTYPE
- PHASE II
- PHASE III
- PHASE IV – SURFACE WATER BASINS
- RECOVERY WELLS INSTALLED AS NEEDED

NORTH

2000 0 2000 4000

SCALE IN METERS

NOTE:

OPTION INCLUDES CAPTURE AND RECHARGE OF 60 MGD INDUCED INFILTRATION WATER AND 90 MGD SURFACE WATER WITH AND WITHOUT 60 MGD DIRECT SURFACE WATER SUPPLY TO WATER TREATMENT PLANTS IN THE CITY.

delivery through existing pipe to the City's water treatment plant.

Also required are overhead power lines and SCADA system, including a radio/ antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 91 miles of fiber optic cable along new and existing pipeline alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plant in Wichita.

The addition of 20 recovery wells would be required to meet the projected year 2050 maximum day worst dry case condition. These wells would be installed between 2010 and 2050 and require additional SCADA radio/antenna equipment, 16 miles of fiber optic cable and 2 miles of transmission piping.

See Figure 2–8 for general layout of the project and phased implementation.

Example of Recovery Well

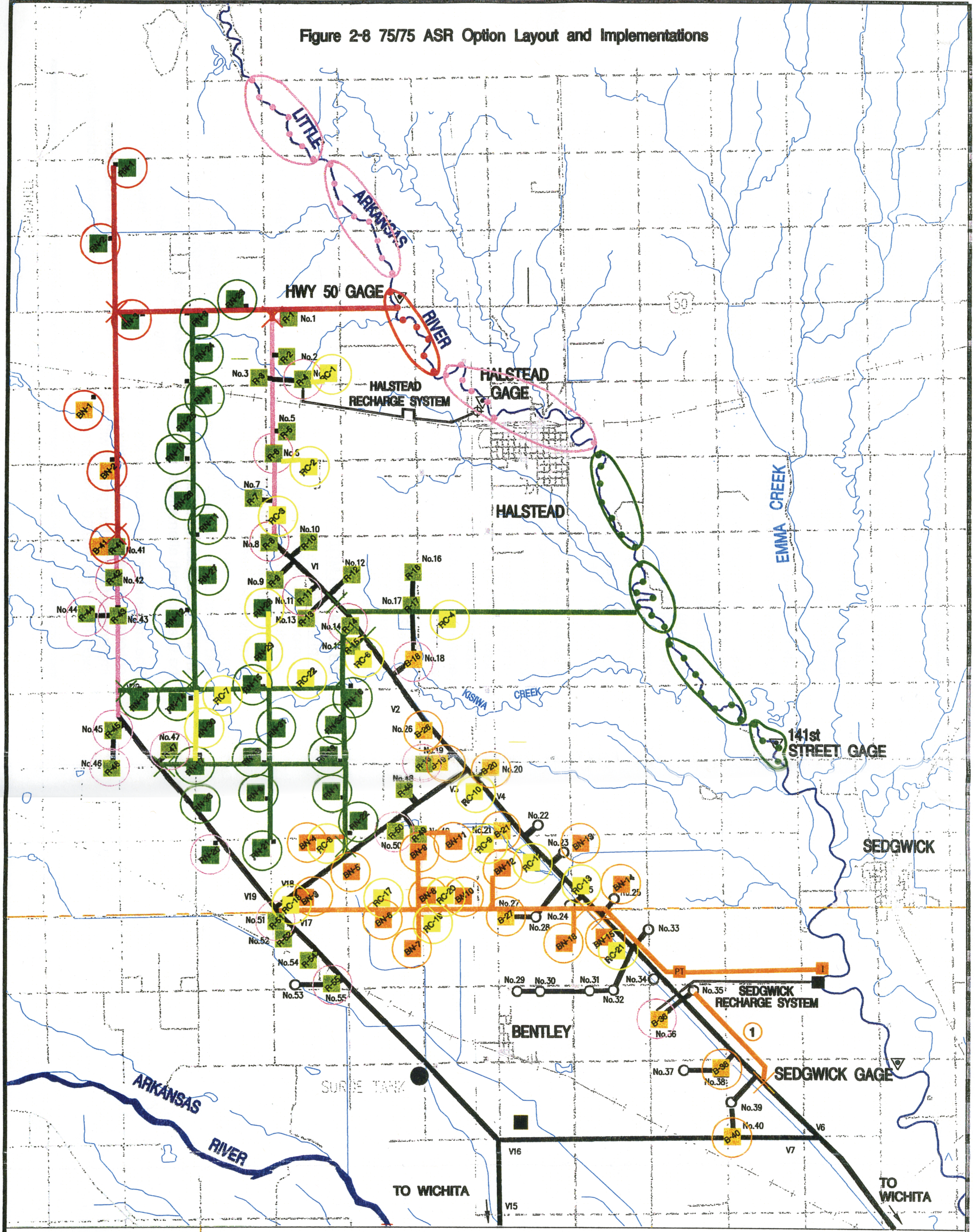
2.3.5.1.3 <u>100/50 ASR Option</u>

This option would capture 100 MGD of induced infiltration water and 50 MGD of surface water from the Little Arkansas River during above base flow conditions. All of the water removed with the induced infiltration wells would be directly recharged into the Equus Beds aquifer while the captured surface water would be treated before being recharged into the aquifer. An additional 60 MGD of surface water, if necessary, could be diverted from the Little Arkansas River, pretreated in a new pre-sedimentation plant and conveyed to the City's water treatment facility.

With the 100/50 ASR Option, 70 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. The induced infiltration wells would be divided into 3 well fields, 1 well field of 28 wells and 5.6 miles of transmission pipeline and 2 well fields of 21 wells and 4.2 miles of transmission pipeline each. Other facilities necessary for the operation of the well and pipeline system would be immediately adjacent to the riparian vegetation in agricultural fields, including a gravel access road immediately adjacent to the wells and pipelines. The bank storage water would be moved via 42 miles of pipeline to 15 recharge wells at existing City of Wichita well sites, 28 new recharge well sites, and 9 recharge basins in the Equus Beds Well Field at existing water supply well sites.

A new surface water intake near Sedgwick, Kansas would directly remove 50 MGD of water from the Little Arkansas River. Approximately 2 miles of pipeline would transfer this untreated surface water to a pre-sedimentation plant; another 8 miles of pipeline would transfer the treated water to 12 new recharge basins in the Equus Beds Well Field.

Figure 2-8 75/75 ASR Option Layout and Implementations



LEGEND

- RECHARGE WELL SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- RECHARGE WELL SITE AT NEW SITE
- RECOVERY WELL SITE AT NEW SITE
- 2-ACRE RECHARGE BASIN SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- 2-ACRE RECHARGE BASIN AT NEW SITE
- 3-ACRE RECHARGE BASIN SITE AT NEW SITE
- PROPOSED DIVERSION WELL SITE
- PROPOSED PRESEDIMENTATION TREATMENT PLANT
- PROPOSED SURFACE WATER INTAKE
- 60 MGD SUPPLY OPTION TO CITY'S WATER PLANT
- PHASE I – PROTOTYPE
- PHASE II
- PHASE III
- PHASE IV – SURFACE WATER BASINS
- RECOVERY WELLS INSTALLED AS NEEDED

NORTH

2000 0 2000 4000

SCALE IN METERS

NOTE:

OPTION INCLUDES CAPTURE AND RECHARGE OF 60 MGD INDUCED INFILTRATION WATER AND 90 MGD SURFACE WATER WITH AND WITHOUT 60 MGD DIRECT SURFACE WATER SUPPLY TO WATER TREATMENT PLANTS IN THE CITY.

If necessary, an additional 60 MGD of surface water could be diverted from the Little Arkansas River. This water would be piped 2 miles to a new pre-sedimentation plant before being conveyed through an existing pipe to the City of Wichita's water treatment plants for further treatment and distribution.

Also required are overhead power lines and SCADA system, including a radio/ antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 97 miles of fiber optic cable along new and existing pipeline alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plant in Wichita.

The addition of 14 recovery wells would be required to meet the projected year 2050 maximum day worst dry case condition. These wells would be installed between 2010 and 2050 and require additional SCADA radio/antenna equipment, 9 miles of fiber optic cable and 0.3 miles of transmission piping.

Figure 2–9 illustrates the general layout of the project option and implementation of the construction.

2.3.5.1.4 <u>150 MGD ASR Option Implementation.</u>

Components of the ASR project are scheduled for implementation over several years to facilitate planning and administrative needs, project funding, engineering, permitting, land acquisition, and construction. Figure 2–10 illustrates the implementation schedule that would be used for both alternatives.

The implementation for each of the three options is very similar. Each option's implementation has four phases with the exception of the 100/50, which has five phases. Phases 1-3 are basically the same for each option. They differ only in the number of recharge wells and basins, in the amount of piping, and in the capacity and number of induced infiltration wells required. Option 100/50 includes an additional phase similar to Phases 1 through 3. Phase 5 of the 100/50 option contains the same tasks as Phase 4 for the 60/90 and 75/75 options. Table 2–3 details the number of wells, recharge basins, miles of pipe and fiber optic cable, and size of intake structure for each of the options per phase.

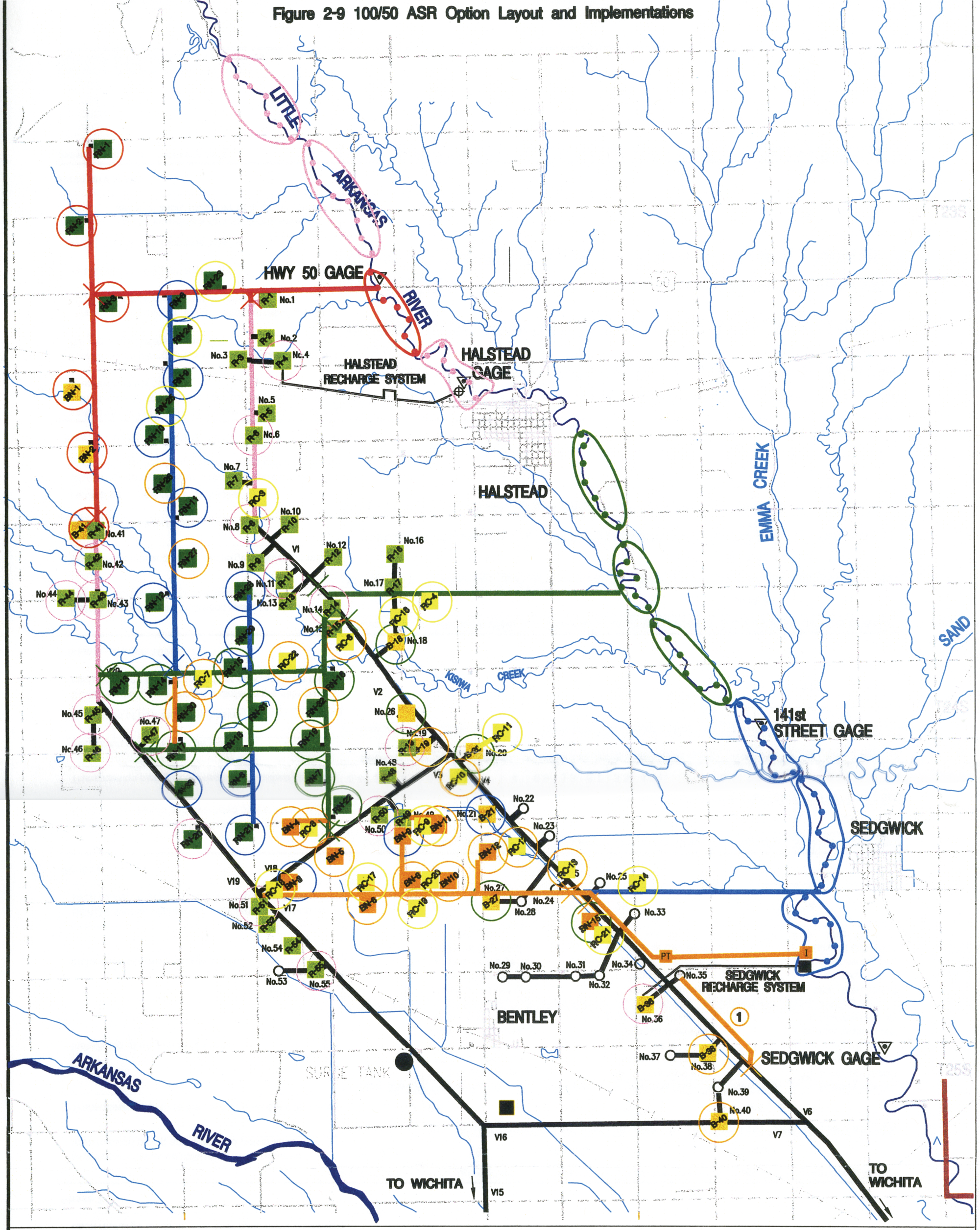
Phase 1 - includes construction of a 10 MGD ASR system. Components include:

- Installation of induced infiltration (diversion) wells and the required transmission piping, and overhead power lines.
- Transmission piping to the recharge facilities including use of various diameters of pipe, i.e. 12-inch, 16-inch, 24-inch, 30-inch, 36-inch, 48-inch pipe.
- Installation of new recharge wells (RN wells).
- Installation of recharge basins at new sites (BN) and existing sites (B).
- SCADA system, including a radio/antenna set-up at each recharge location, plus various miles of fiber optic cable along pipe alignment.

Phase 2 - includes the installation of additional diversion wells, recharge wells at existing sites, use of recently redrilled wells with let-down casings, use of the existing demonstration project recharge facilities, and expanded use of the transmission piping installed in Phase 1.

Phase 3 - includes installation of additional diversion wells, recharge wells

Figure 2-9 100/50 ASR Option Layout and Implementations



LEGEND

- RECHARGE WELL SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- RECHARGE WELL SITE AT NEW SITE
- RECOVERY WELL SITE AT NEW SITE
- 2-ACRE RECHARGE BASIN SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- 2-ACRE RECHARGE BASIN AT NEW SITE
- 3-ACRE RECHARGE BASIN SITE AT NEW SITE
- PROPOSED DIVERSION WELL SITE
- PROPOSED PRESEDIMENTATION TREATMENT PLANT
- PROPOSED SURFACE WATER INTAKE
- 60 MGD SUPPLY OPTION TO CITY'S WATER PLANT
- PHASE I – PROTOTYPE
- PHASE II
- PHASE III
- PHASE IV – SURFACE WATER BASINS
- RECOVERY WELLS INSTALLED AS NEEDED

NORTH

2000 0 2000 4000

SCALE IN METERS

NOTE:

OPTION INCLUDES CAPTURE AND RECHARGE OF 60 MGD INDUCED INFILTRATION WATER AND 90 MGD SURFACE WATER WITH AND WITHOUT 60 MGD DIRECT SURFACE WATER SUPPLY TO WATER TREATMENT PLANTS IN THE CITY.

Table 2-3 150 MGD Alternative - Options Phase Implementation

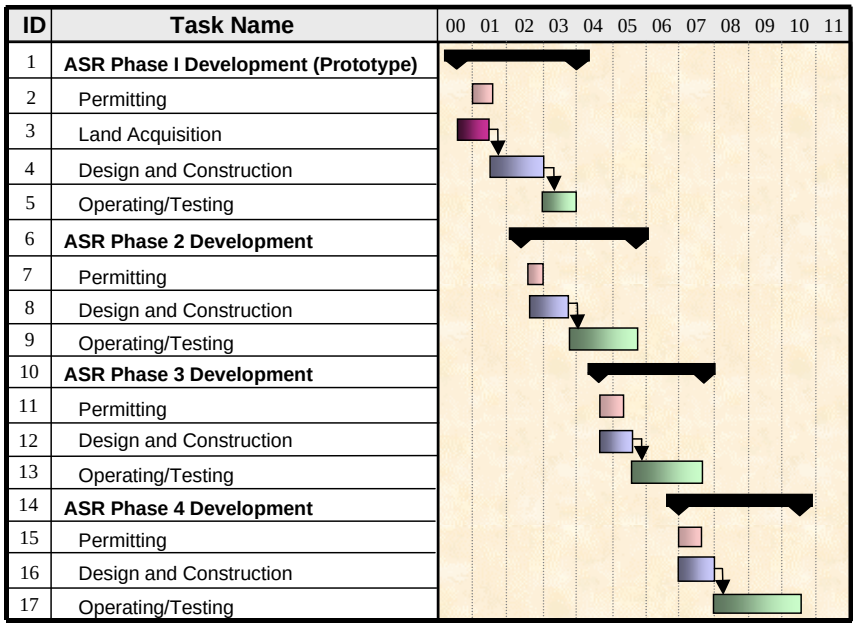
Phases	60/90 Option							75/75 Option							100/50 Option						
Phase 1																					
	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
Installation of induced infiltration wells, required transmission piping and overhead power lines	10 MGD			7				10 MGD			7				10 MGD			7			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)	1.2	1.4	0.4	3	1.2	1	2	1	1	0.2	3.6	1.4	1	2	1	1	0.2	3.6	1.4	1	2
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge wells	3							3							3						
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge basins	2			1				2			1				2			1			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	10							10							11						
Phase 2																					
	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
Installation of induced infiltration wells, required transmission piping and overhead power lines	20 MGD			15				30 MGD			21				30 MGD			21			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)	0.2	0.2	5.2	0.6	1			0.4	0.8	6	1.6	1			0.4	0.8	6	1.6	1		
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge wells	1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4				1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4				1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4			
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge basins				1; also activation of demonstration project recharge basins at City Well No. 36							1; also activation of demonstration project recharge basins at City Well No. 36							1; also activation of demonstration project recharge basins at City Well No. 36			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	21							25							24						
Phase 3																					
	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
Installation of induced infiltration wells, required transmission piping and overhead power lines	30 MGD			20				35 MGD			25				30 MGD			21			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)	0.4	2.8	8.7	2.6	4.4		4	0.9	3.3	8.7	3.3	4.6		4	0.4	2.8	6.2	1	3.7		4
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge wells	14							24							10						
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge basins															1			2			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	12							21							11						
Phase 4 - Option 100/50																					
	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
Installation of induced infiltration wells, required transmission piping and overhead power lines															30 MGD			21			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)															1.4	1.8	4.2	2.6	1.1		3
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge wells															10						
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge basins															2			3			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)															15						
Phase 4 - Option 60/90 and 75/75, Phase 5 - Option 100/50																					
Installation of surface water intake, transmission piping from the intake to the pre-sedimentation plant, and overhead power lines	150 MGD Intake Structure Capacity							135 MGD Intake Structure Capacity							110 MGD Intake Structure Capacity						
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the pre-sedimentation plant to the recharge basins (in miles)		2.5	4			7.5			2	1.5			7.5			1	1.5		1	4.5	1.5
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the pre-sedimentation plant to City's water treatment plant (in miles)							2							2							2
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge wells															4						
	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
Installation of new recharge basins	18			9				14			7				7			2			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	43							42							36						
Recovery Wells																					
Installation of future recovery wells	Number of Wells							Number of Wells							Number of Wells						
2010	0							0							0						
2020	6							0							0						
2030	9							4							0						
2040	8							9							6						
2050	7							12							9						
Installation of fiber optic cable (in miles)	5							16							9						
Installation of transmission piping (in miles	3							2							0.3						

at new sites, and additional transmission pipe.

Phase 4 - includes construction of the surface water intake, pretreatment plant, and recharge basins.

Recovery wells would be required to supply raw water to the city's water plants to meet maximum day demands during worst case conditions. The schedule for the installation of recovery wells for the 60/90 ASR Option is listed in Table 2–3. The recovery wells would require additional SCADA radio/antenna equipment and fiber optic cable.

Figure 2-10 ASR Project Implementation Schedule



2.3.5.1.5 150 MGD ASR Alternative Costs

The estimated construction costs for this alternative range from $334 to $312 million (2000 dollars) depending on which option is used and whether 60 MGD is diverted to the City's Water Treatment Plant (Table 2-4). Annual operation, maintenance, and energy (OMR&E) costs are estimated to range from $6.82 to $5.24 million (2000 dollars) depending on which option is used and whether 60 MGD is diverted to the City 's Water Treatment Plant (2000 dollars).

2.3.5.2 Alternative 2 – 100 MGD ASR

This component consists of three options for capturing 100 MGD of above base flow water from the Little Arkansas River. This includes surface water intake, induced infiltration wells, facilities to transfer and recharge the captured water to the aquifer, and to recover the stored water. A pre-sedimentation plant is proposed to treat

Table 2-4 ILWSP 150 ASR Alternative Costs* per Option

Option	Construction Costs		OMR&E Costs	
	With 60 MGD	Without 60 MGD	With 60 MGD	Without 60 MGD
60/90	$333,300,000	$314,700,000	$6,823,000	$5,909,000
75/75	$332,300,000	$312,700,000	$6,541,000	$5,614,000
100/50	$334,000,000	$314,200,000	$6,169,000	$5,239,000

*Note these cost include all the components of the ILWSP.

surface water before recharging into the aquifer or piping to the City's water treatment plants.
Each of the three options are considered with and without capturing and diverting 60 MGD of treated surface water to the City's treatment facilities. Only 100 MGD of above base flow from the Little Arkansas River would be captured without the additional 60 MGD surface water intake. This 100 MGD of captured water would be used for recharge, storage, and recovery in the Equus Bed aquifer.

Options to Alternative 2 for a 100 MGD capture and recharge system include:

- 60/40 ASR Options: Capture of 60 MGD of induced infiltration water for recharge and 40 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD direct to the City water treatment facilities.
- 75/25 ASR Options: Capture of 75 MGD of induced filtration water for recharge and 25 MGD of surface water for treatment and recharge with additional option to capture, pre-treat and convey 60 MGD direct to the City water treatment facilities.
- 100/0 ASR Option: Capture of 100 MGD of induced infiltration water for recharge and no surface will be used for recharge; however, there is an additional option to capture, pre-treat and convey 60 MGD direct to the City water treatment facilities. The pre-sedimentation plant in this plan could be located adjacent to the Central Water Treatment Plant.

Figure 2–11 illustrates each of the three options.

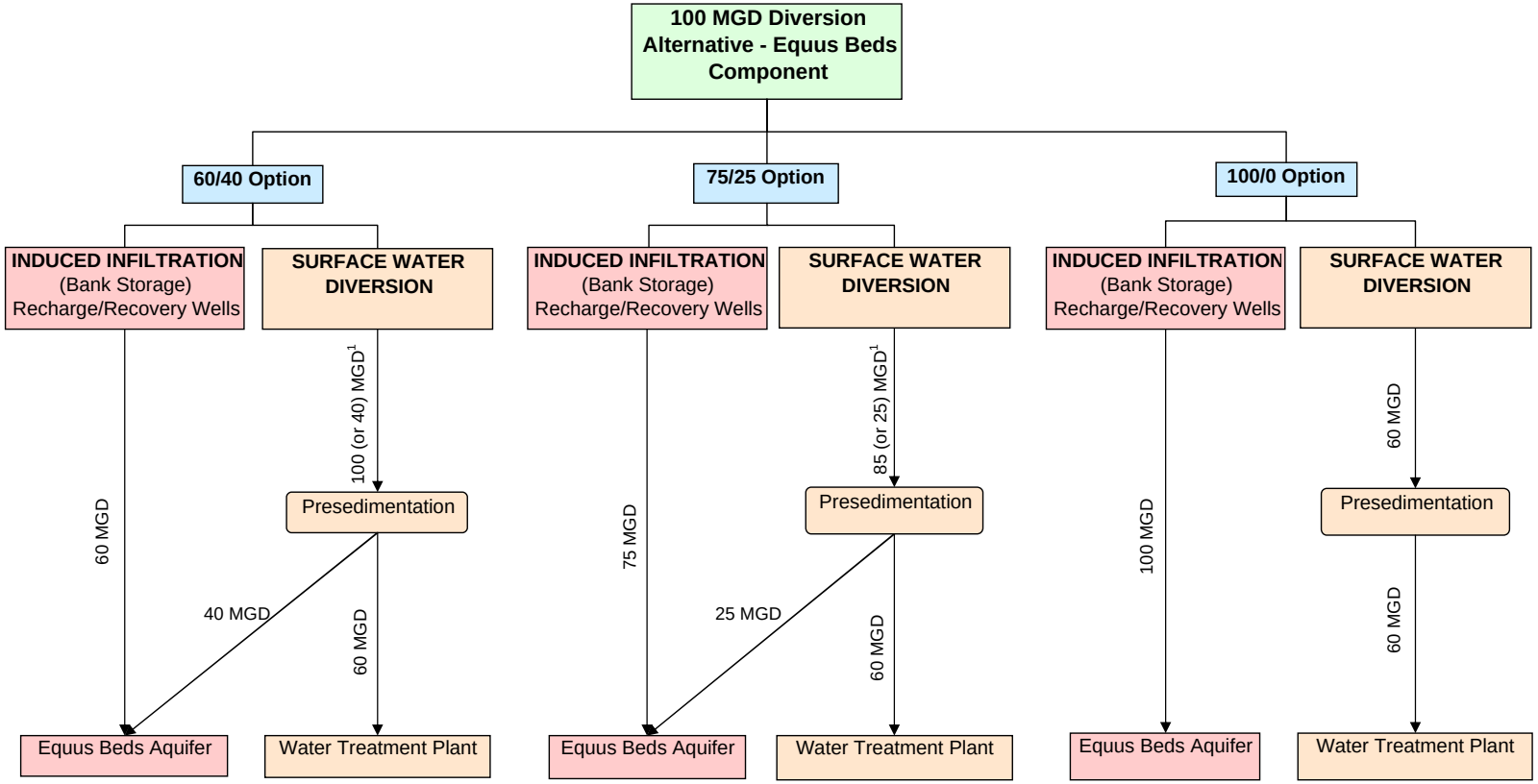
2.3.5.2.1 60/40 ASR Option

This option would capture 60 MGD of induced infiltration groundwater and 40 MGD of surface water from the Little Arkansas River during above base flow conditions. All of the water removed with the induced infiltration wells would be recharged into the Equus Beds aquifer while the captured surface water would be pretreated before recharge into the aquifer. An additional 60 MGD of surface water, if necessary, would be diverted from the Little Arkansas River, piped to a new pre-sedimentation plant and then conveyed to the City's water treatment facilities.

With the 60/40 ASR Option, 42 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. The 42 induced infiltration wells would be divided into two groups of 21 wells with each well field requiring 4.2 miles of transmission pipe. A transmission pipe connects each group of 21 induced infiltration wells to the Equus Beds Well Field, and a gravel access road is immediately adjacent to the wells and pipelines. Other facilities necessary for the operation of the wells and pipeline system are located immediately adjacent to the riparian vegetation in the agricultural fields. The bank storage water would be moved via 42 miles of pipeline to 15 recharge wells at existing City of Wichita well sites, 18 new recharge well sites, and 4 recharge basins in the Equus Beds Well Field near existing water supply wells.

A surface water intake near Sedgwick, Kansas, would directly remove 40 MGD of water from the Little Arkansas River. Approximately 2 miles of pipe would

Figure 2-11 100 MGD ASR Alternative Options



1. Each of the three options is considered with and without 60 MGD of treated surface water to be conveyed to the City treatment facilities. Therefore, the amount diverted increases when 60 MGD is conveyed to the City.

transfer this untreated surface water to a pre-sedimentation plant; another 7.5 miles of pipeline transfers the pretreated water to 12 new recharge basins in the Equus Beds Well Field. If the option of diverting an additional 60 MGD of surface water is implemented, then a total of 100 MGD of water would be diverted from the river. The additional flow would be piped approximately 2 miles through new pipe to a pre-sedimentation plant for pretreatment. The pretreated water is then conveyed 2 miles to existing pipe, which would carry the water to the City's water treatment facilities.

Also required are overhead power lines and SCADA system, including a radio/ antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 62 miles of fiber optic cable along new and existing pipeline alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plant in Wichita.

The addition of 31 recovery wells would be required to meet the projected year 2050 maximum day worst dry case condition. These wells would be installed between 2010 and 2050 and require additional SCADA radio/antenna equipment, 5 miles of fiber optic cable and 5 miles of transmission piping.

See Figure 2–12 for an illustration depicting the general layout of the project option and implementation.

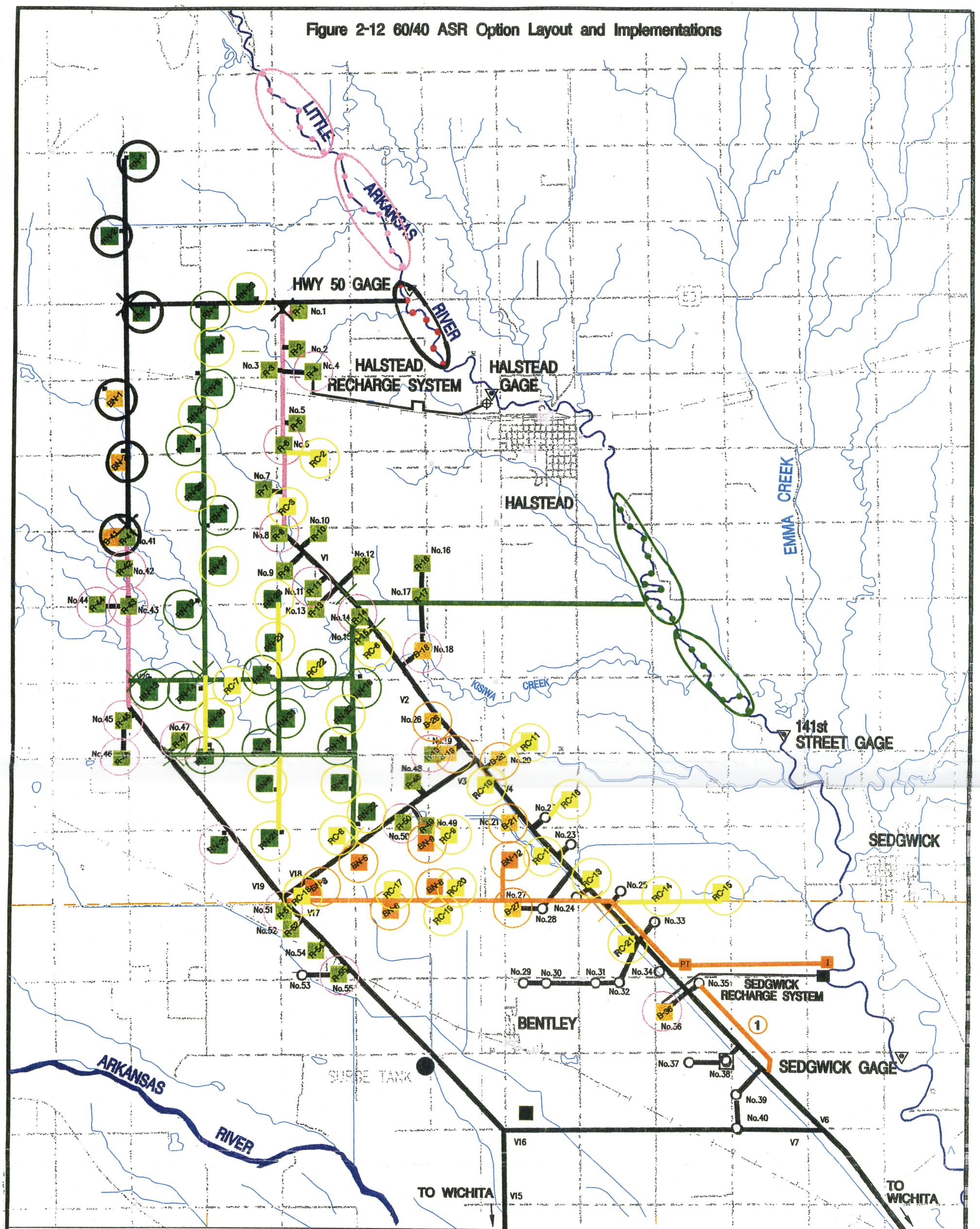
2.3.5.2.2 75/25 ASR Option

This option would capture 75 MGD of induced infiltration water and 25 MGD of surface water from the Little Arkansas River during above base flow conditions. All of the water removed with the induced infiltration wells would be used to recharge the Equus Beds aquifer while 25 MGD of captured surface water would be pretreated for recharge into the aquifer. This option includes the possibility of an additional 60 MGD of surface water to be treated and conveyed to the City's water treatment facility.

With the 75/25 ASR Option, 53 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. The 53 induced infiltration wells would be divided into two groups of 28 and 25 wells with the well fields using 5.6 and 5.0 miles of transmission pipeline, respectively. A transmission pipe would connect each group of induced infiltration wells to the Equus Beds Well Field, and a gravel access road would be immediately adjacent to the wells and pipelines. Other facilities necessary for the operation of the well and pipeline system would be immediately adjacent to the riparian vegetation in agricultural fields. The bank storage water would be moved via 34 miles of pipeline to 15 recharge wells at existing City of Wichita well sites, 27 new recharge well sites, and 4 recharge basins.

A diversion facility near Sedgwick, Kansas would directly remove 25 MGD of water from the Little Arkansas River via a new surface water intake. Approximately 2 miles of pipeline transfer this untreated surface water to a proposed pre-sedimentation plant; another 10 miles of pipeline would transfer 25 MGD of the treated water to 7 new recharge basins in the Equus Beds Well Field. If selected, an additional 60 MGD of surface water could be diverted from the Little Arkansas River, pass through 2 miles of pipe to the pre-sedimentation plant, and then through

Figure 2-12 60/40 ASR Option Layout and Implementations



LEGEND

- RECHARGE WELL SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- RECHARGE WELL SITE AT NEW SITE
- RECOVERY WELL SITE AT NEW SITE
- 2-ACRE RECHARGE BASIN SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- 2-ACRE RECHARGE BASIN AT NEW SITE
- 3-ACRE RECHARGE BASIN SITE AT NEW SITE
- PROPOSED DIVERSION WELL SITE
- PROPOSED PRESEDIMENTATION TREATMENT PLANT
- PROPOSED SURFACE WATER INTAKE
- 60 MGD SUPPLY OPTION TO CITY'S WATER PLANT
- PHASE I – PROTOTYPE
- PHASE II
- PHASE III
- PHASE IV – SURFACE WATER BASINS
- RECOVERY WELLS INSTALLED AS NEEDED

NORTH

2000 0 2000 4000

SCALE IN METERS

NOTE:

OPTION INCLUDES CAPTURE AND RECHARGE OF 60 MGD INDUCED INFILTRATION WATER AND 90 MGD SURFACE WATER WITH AND WITHOUT 60 MGD DIRECT SURFACE WATER SUPPLY TO WATER TREATMENT PLANTS IN THE CITY.

existing pipe to the City of Wichita's water treatment plants for further treatment and distribution.

Also required are overhead power lines and SCADA system, including a radio/ antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 71 miles of fiber optic cable along new and existing pipeline alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plant in Wichita.

The addition of 21 recovery wells would be required to meet the projected year 2050 maximum dry case condition. These wells would be installed between 2010 and 2050 and require additional SCADA radio/antenna equipment, 9 miles of fiber optic cable and 2 miles of transmission piping.

Figure 2–13 illustrates the general layout of the project option and implementation of the construction.

2.3.5.2.3 100/0 ASR Option

This option would capture 100 MGD of induced infiltration water during above base flow conditions. No surface water from the Little Arkansas River will be used for recharge. All of the water removed using the induced infiltration wells would be used to recharge the Equus Beds aquifer. This option includes an option to capture an additional 60 MGD of surface water from the Little Arkansas River, which would be conveyed through a new pre-sedimentation plant and on to the City's water treatment facility.

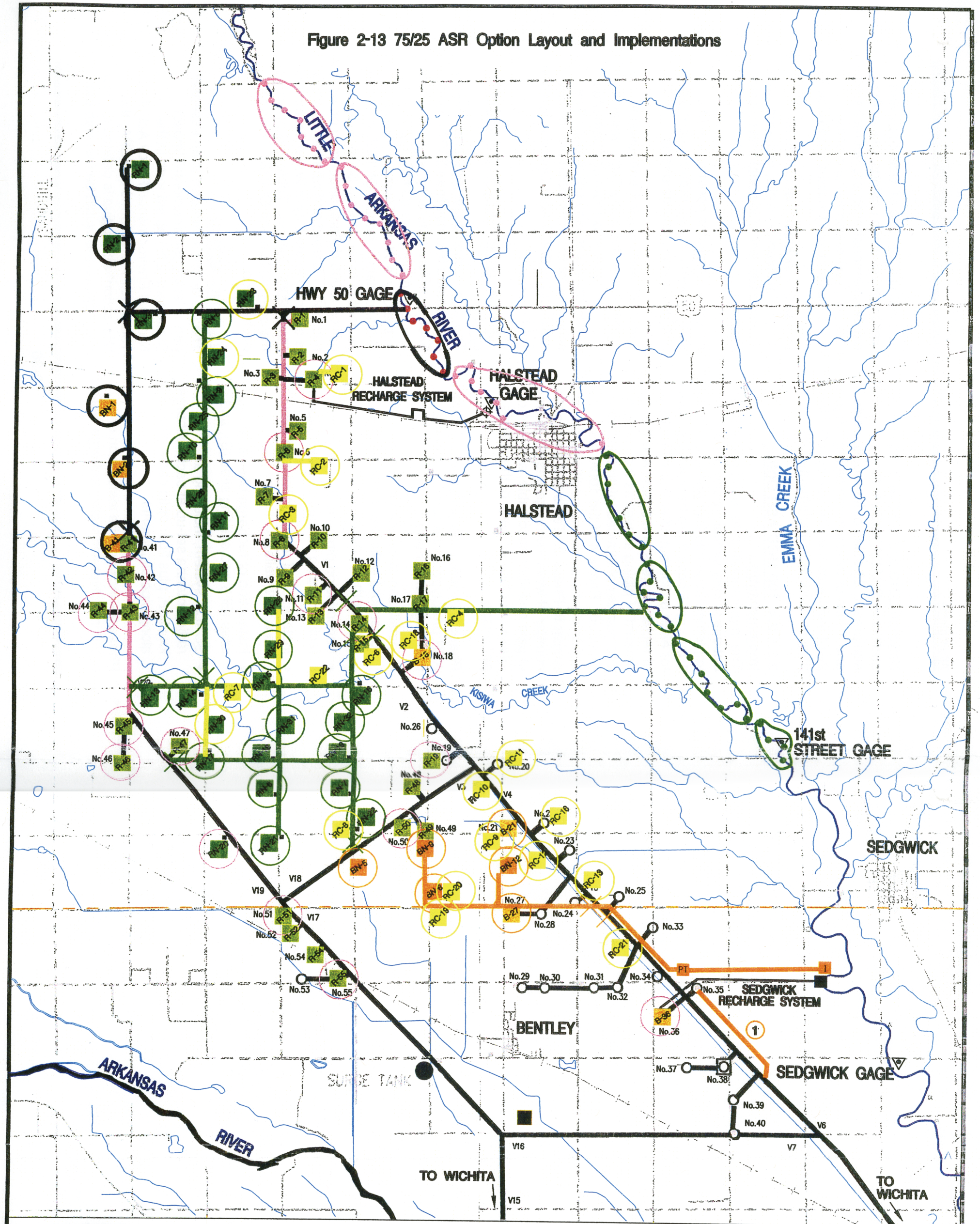
With the 100/0 ASR Option, 70 induced infiltration wells would be installed on the banks of the Little Arkansas River. All wells would be located to the maximum extent possible outside of the existing riparian vegetation found along the banks of the river. The induced infiltration wells would be divided into three well fields, one well field of 28 wells and 5.6 miles of transmission pipe and two well fields of 21 wells and 4.2 miles of transmission pipe each. A transmission pipe would connect each group of induced infiltration wells to the Equus Beds Well Field, and a gravel access road would be located immediately adjacent to the wells and pipelines. Other facilities necessary for the operation of the well and pipeline system would also be immediately adjacent to the riparian vegetation in agricultural fields. The "bank storage" water would be moved via 47 miles of pipeline to 16 recharge wells at existing City of Wichita well sites, 28 new recharge well sites, and 11 recharge basins at existing water supply well sites.

An optional surface water intake near Sedgwick, Kansas, would directly remove 60 MGD of water from the Little Arkansas River. The surface water passes through 2 miles of pipe to the pre-sedimentation plant, and is then piped 2 miles to existing pipe and onto the City of Wichita's water plants for further treatment and distribution.

Also required are overhead power lines and SCADA system, including a radio/ antenna set-up at each diversion, recharge and recharge/recovery location, plus approximately 89 miles of fiber optic cable along new and existing pipe alignments in the well field and 15 miles along a new transmission pipeline to the City's Water Treatment Plant in Wichita.

The addition of 21 recovery wells would be required to meet the projected year 2050 maximum day worst dry case condition. These wells would be installed

Figure 2-13 75/25 ASR Option Layout and Implementations



LEGEND

- RECHARGE WELL SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- RECHARGE WELL SITE AT NEW SITE
- RECOVERY WELL SITE AT NEW SITE
- 2-ACRE RECHARGE BASIN SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- 2-ACRE RECHARGE BASIN AT NEW SITE
- 3-ACRE RECHARGE BASIN SITE AT NEW SITE
- PROPOSED DIVERSION WELL SITE
- PROPOSED PRESEDIMENTATION TREATMENT PLANT
- PROPOSED SURFACE WATER INTAKE
- 60 MGD SUPPLY OPTION TO CITY'S WATER PLANT
- PHASE I – PROTOTYPE
- PHASE II
- PHASE III
- PHASE IV – SURFACE WATER BASINS
- RECOVERY WELLS INSTALLED AS NEEDED

NORTH

2000 0 2000 4000

SCALE IN METERS

NOTE:

OPTION INCLUDES CAPTURE AND RECHARGE OF 60 MGD INDUCED INFILTRATION WATER AND 90 MGD SURFACE WATER WITH AND WITHOUT 60 MGD DIRECT SURFACE WATER SUPPLY TO WATER TREATMENT PLANTS IN THE CITY.

between 2010 and 2050 and require additional SCADA radio/antenna equipment, 23 miles of fiber optic cable and 1 mile of transmission piping. Figure 2–14 illustrates the general layout of the project option and implementation.

2.3.5.2.4 100 MGD ASR Option Implementation

The implementation for each of the three options is very similar. Each option implementation has four phases. Phase 1 through Phase 3 are basically the same for each option but differ in the numbers of recharge wells and basins and the amount of piping as well as the capacity and number of induced infiltration wells required. Phase 4 of the 100/0 ASR option contains several additional tasks similar to Phase 3. Table 2–5 details the number of wells, recharge basins, miles of pipe and fiber optic cable, and size of intake structure for each of the options per phase.

Phase 1 includes the construction of the ASR prototype and would contain the following components:

- installation of induced infiltration (diversion) wells, transmission piping and overhead power lines;
- transmission piping to the recharge facilities using various diameter pipes;
- installation of recharge wells at new sites (RN wells);
- installation of recharge basins, at new sites (BN) and existing sites (B); and
- SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable placed along pipe alignments.

Phase 2 - includes the installation of additional diversion wells, recharge wells at existing sites, use of recent redrilled wells with let-down casings, use of the existing demonstration project recharge facilities, and expanded use of the transmission piping installed in Phase 1.

Phase 3 - includes installation of additional diversion wells, recharge wells at new sites, and additional transmission piping.

Phase 4 - includes construction of a surface water intake, pretreatment plant and additional recharge basins.

Recovery wells would be required to supply raw water to the City's water plants to meet maximum day demands during dry worst case conditions. The schedule for the installation of recovery wells for the 60/40 ASR Option is listed in Table 2–5.

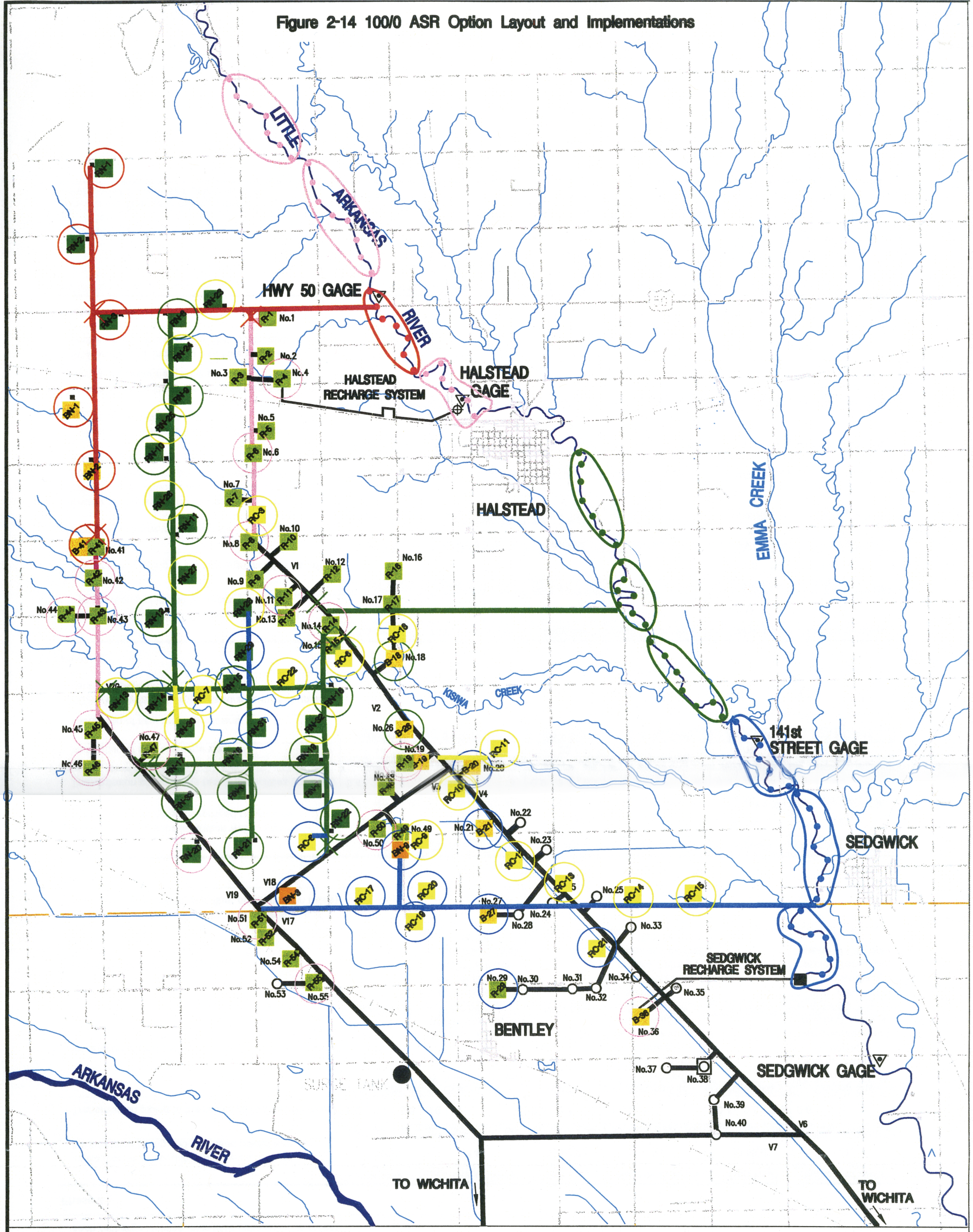
2.3.5.2.5 100 MGD ASR Alternative Costs

The construction costs for this alternative is estimated to range from $307.0 to $283.5 million depending on which option is used and whether 60 MGD is diverted to the City 's Water Treatment Plant (2000 dollars). Annual OMR&E costs are estimated to range from $5.82 to $3.50 million (2000 dollars) depending on which sub-option is used and whether 60 MGD is diverted to the City 's Water Treatment Plant (2000 dollars). Table 2–6 provides the construction and OMR&E costs for each option.

2.3.6 NO-ACTION

The No-action alternative is an essential part of every Environmental Impact Statement (EIS) as set forth in the National Environmental Policy Act of 1969 (NEPA). In terms of NEPA, the "No-action" alternative is defined as how the project need would be met with the

Figure 2-14 100/0 ASR Option Layout and Implementations



LEGEND

- RECHARGE WELL SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- RECHARGE WELL SITE AT NEW SITE
- RECOVERY WELL SITE AT NEW SITE
- 2-ACRE RECHARGE BASIN SITE AT EXISTING CITY OF WICHITA WELL FACILITY
- 2-ACRE RECHARGE BASIN AT NEW SITE
- 3-ACRE RECHARGE BASIN SITE AT NEW SITE
- PROPOSED DIVERSION WELL SITE
- PROPOSED PRESEDIMENTATION TREATMENT PLANT
- PROPOSED SURFACE WATER INTAKE
- 60 MGD SUPPLY OPTION TO CITY'S WATER PLANT
- PHASE I – PROTOTYPE
- PHASE II
- PHASE III
- PHASE IV – SURFACE WATER BASINS
- RECOVERY WELLS INSTALLED AS NEEDED

NORTH

2000 0 2000 4000

SCALE IN METERS

NOTE:

OPTION INCLUDES CAPTURE AND RECHARGE OF 60 MGD INDUCED INFILTRATION WATER AND 90 MGD SURFACE WATER WITH AND WITHOUT 60 MGD DIRECT SURFACE WATER SUPPLY TO WATER TREATMENT PLANTS IN THE CITY.

Table 2-5 100 MGD Alternative - Options Phase Implementation

Phases	60/40 Option							75/25 Option							100/0 Option						
Phase 1																					
Installation of induced infiltration wells, required transmission piping and overhead power lines	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
	10 MGD			7				10 MGD			7				10 MGD			7			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)	1.2	1.4	0.4	3	1	1	2	1	1	0.2	3.6	1.4	1	2	1	1	0.2	3.6	1.4	1	2
Installation of new recharge wells	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
	3							3							3						
Installation of new recharge basins	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
	2			1				2			1				2			1			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	10							11							11						
Phase 2																					
Installation of induced infiltration wells, required transmission piping and overhead power lines	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
	20 MGD			14				30 MGD			21				30 MGD			21			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)	0.2	0.2	5.2	0.6	1			0.4	0.8	6	1.6	1			0.4	0.8	5.9	0.6	1		
Installation of new recharge wells	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
	1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4				1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4				1			15; 5 equipped with letdown casings, one is demonstration well at City Well No. 4			
Installation of new recharge basins	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
				1; also activation of demonstration project recharge basins at City Well No. 36							1; also activation of demonstration project recharge basins at City Well No. 36							1; also activation of demonstration project recharge basins at City Well No. 36			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	21							25							24						
Phase 3																					
Installation of induced infiltration wells, required transmission piping and overhead power lines	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
	30 MGD			21				35 MGD			25				30 MGD			21			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)	0.4	2.8	8.7	2.6	4.4		4	0.9	3.3	8.7	3.3	4.6		4	0.9	3.3	8.7	3	4.2		4
Installation of new recharge wells	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
	14							23							16						
Installation of new recharge basins	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
																		2			
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	12							21							13						
Phase 4																					
Installation of induced infiltration wells, required transmission piping and overhead power lines	Capacity			Number of Wells				Capacity			Number of Wells				Capacity			Number of Wells			
															30 MGD			21			
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the recharge facilities (in miles)															1.4	1.8	1.7	0.6	0.6	4.5	3
Installation of new recharge wells	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
															8			1			
Installation of new recharge basins	New Site			Existing Site				New Site			Existing Site				New Site			Existing Site			
	6			5				4			2				2			3			
Installation of surface water intake, transmission piping from the intake to the pre-sedimentation plant, and overhead power lines	100 MGD Intake Structure Capacity							85 MGD Intake Structure Capacity							60 MGD Intake Structure Capacity						
	12"	16"	24"	30"	36"	48"	54"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the pre-sedimentation plant to the recharge basins (in miles)		1.5				4.5	1.5		1.5		2.5			6							
	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"	12"	16"	24"	30"	36"	48"	60"
Transmission piping to the pre-sedimentation plant to City's water treatment plant (in miles)							2							2							2
SCADA system, including a radio/antenna set-up at each recharge location, plus fiber optic cable (in miles)	29							22							33						

Recovery Wells

Installation of future recovery wells	Number of Wells	Number of Wells	Number of Wells
2010	0	0	0
2020	6	0	0
2030	9	4	4
2040	8	9	9
2050	8	8	8
Installation of fiber optic cable (in miles)	5	9	23
Installation of transmission piping (in miles	5	2	1

Table 2-6 ILWSP 100 ASR Alternative Costs per Option

Option	Construction Costs		OMR&E Costs	
	With 60 MGD	Without 60 MGD	With 60 MGD	Without 60 MGD
60/40	$305,900,000	$285,300,000	$5,815,000	$4,877,000
75/25	$303,800,000	$283,500,000	$5,600,000	$4,643,000
100/0	$307,000,000	$285,400,000	$4,473,000	$3,497,000

Note these costs include all ILWSP components in 2000 dollars.

status quo. In this case, the No-action alternative is defined as no construction and no provision of an expanded water supply to meet projected population growth needs. The No-action alternative is included to help establish the baseline from which the final action alternatives are evaluated. Water conservation alternatives have also been included in the EIS as a result of input received during project scoping meetings.

The No-action alternative reduces the net water need through self-imposed growth limitations. The City would continue water service to their existing retail and wholesale customers, but would not serve any additional wholesale customers, and would not provide for projected population increases outside of their existing service area.

2.4 SUMMARY OF ENVIRONMENTAL IMPACTS

Chapter 4 identifies the environmental impacts associated with the proposed action. Table 2–7 summarizes the impact of the proposed actions and the No-action alternatives at Wichita, Kansas in the area of the Equus Beds Well Field, Bentley Reserve Well Field, Cheney Reservoir and along the Little Arkansas River. No significant impacts are expected for the evaluated resources from water conservation or the No-action alternative.

2.5 PREFERRED ALTERNATIVE

The City of Wichita's preferred alternative is the ILWSP with 100 MGD ASR with the 75/25 ASR Option. The ILWSP would help to preserve the Equus Beds aquifer for use by future generations. Recharging the aquifer would protect the ground water from chloride plumes migrating towards the well field and provide a large volume of stored groundwater for future use.

Table 2-7 Summary of Beneficial and Adverse Environmental Impacts

Resources	Integrated Local Water Supply Plans		No-Action
	150 MGD Diversion Alternative	100 MGD Diversion Alternative	
Geology	Minor surface changes due to excavation of foundations and access road.	Minor surface changes due to excavation of foundations and access road	None
Soils	Temporary soil disturbance and increased erosion potential during construction.	Temporary soil disturbance and increased erosion potential during construction.	None
Land Use	Conversion of approximately 200 acres in the area of the Equus Beds Well Field to non-farm use.	Conversion of approximately 200 acres in the area of the Equus Beds Well Field to non-farm use.	Slow current rate of conversion from agricultural lands to residential developments.
Water Resources *Surface Water* Quantity			
Little Arkansas River	Above Wichita, low flows will increase. Median flows will increase, except during May and June when the flows will decrease. High flows will remained unchanged. Below local well field expansion, flow will be reduced to 20 cfs 80 percent of time.	Above Wichita, low flows will increase. Median flows will increase, except during May and June when the flows will decrease. High flows will remained unchanged. Below local well field expansion, flow will be reduced to 20 cfs 80 percent of time.	Lower flows that occur a majority of the time will continue to decline.
Arkansas River	The median flows will be equal expect in June when the flow would decrease due to diversion of water for recharge.	The median flows will be equal expect in June when the flow would decrease due to diversion of water for recharge.	None
Ninnescah River Basin	Flows will increase downstream of Cheney Reservoir during more frequent reservoir releases.	Flows will increase downstream of Cheney Reservoir during more frequent reservoir releases.	Flows will decrease due to less frequent releases from Cheney Reservoir.
Cheney Reservoir	Increased volume of water stored in reservoir.	Increased volume of water stored in reservoir.	Decrease in volume of water stored in reservoir.
Surface Elevations and Depths			
Little Arkansas River	Median water levels and depths will increase 0.1 foot in most months.	Median water levels and depths will increase 0.1 foot in most months.	Median water levels will decrease 0.05 foot every month.
Arkansas River	Median stage values will decrease 0.2 foot each month.	Median stage values will decrease 0.2 foot each month.	Median river stages will decrease 0.05 – 0.20 foot.
Ninnescah River	None	None	Slight decrease in median stages in some months.
Cheney Reservoir	Water Levels will be 0.4 - 0.6 foot higher.	Water Levels will be 0.4 - 0.6 foot higher.	Water levels will be 2-3 feet lower.
Quality			
Little Arkansas River	None	None	Decrease in groundwater discharge, reducing quantity of better-quality water.

Table 2-7 Summary of Beneficial and Adverse Environmental Impacts

Resources	Integrated Local Water Supply Plans		No-Action
	150 MGD Diversion Alternative	100 MGD Diversion Alternative	
Arkansas River	Total dissolved solids concentrations will increase by 6 percent, suspended sediment will increase by 4 percent, and chloride concentrations will increase by 7 percent.	Total dissolved solids concentrations will increase by 6 percent, suspended sediment will increase by 4 percent, and chloride concentrations will increase by 7 percent.	None
Ninnescah River	None	None	Water releases from Cheney Reservoir will decline, providing less water for dilutio downstream.
Cheney Reservoir	Slight improvement due to more water in storage.	Slight improvement due to more water in storage.	Modest decline in water quality due to less storage.
Groundwater			
Water Levels			
Equus Beds aquifer	Water levels are generally higher and recover faster after drought.	Water levels are generally higher and recover faster after drought.	Water levels decline with little hope of recovering.
Little Arkansas River alluvium	Declines up to 30 feet adjacent to operating wells but wells do not operate continuously and water levels recover quickly when wells are inactive.	Declines up to 30 feet adjacent to operating wells but wells do not operate continuously and water levels recover quickly when wells are inactive.	None
Arkansas River alluvium	Declines up to 30 feet within Bentley Reserve well field but these wells will be operated infrequently.	Declines up to 30 feet within Bentley Reserve well field but these wells will be operated infrequently.	None
Quality			
Equus Beds aquifer	Infiltration rate and rate of salinity contamination will decrease.	Infiltration rate and rate of salinity contamination will decrease.	Infiltration rate and rate of salinity contamination will increase dramatically.
Little Arkansas River alluvium	None	None	None
Arkansas River alluvium	None	None	None
Water Rights	None	None	None
Air Quality	Temporary localized increases in NOx, CO, SO2, and PM10 during construction.	Temporary localized increases in NOx, CO, SO2, and PM10 during construction.	None
Noise	Temporary localized increased level during construction.	Temporary localized increased level during construction.	None
Biological Resources			None
Wetlands	Temporary impact due to construction	Temporary impact due to construction	None
Vegetation	Permanent loss of 360 acres of vegetation	Permanent loss of 266 acres of vegetation	None
Wildlife	Temporary displacement of species during construction.	Temporary displacement of species during construction.	None
Fish			

Table 2-7 Summary of Beneficial and Adverse Environmental Impacts

Resources	Integrated Local Water Supply Plans		No-Action
	150 MGD Diversion Alternative	100 MGD Diversion Alternative	
Little Arkansas River	Slight decrease in habitat due to periodic water diversion	Slight decrease in habitat due to periodic water diversion	None
North Fork Ninnescah River	Slight increase in habitat due to increased frequency of discharge	Slight increase in habitat due to increased frequency of discharge	None
Arkansas River	Slight decrease in habitat immediately below confluence with the Little Arkansas River due to periodic decrease in flows in the Little Arkansas River.	Slight decrease in habitat immediately below confluence with the Little Arkansas River due to periodic decrease in flows in the Little Arkansas River.	None
Threatened, Endangered, and Candidate Species	Temporary displacement of species during construction.	Temporary displacement of species during construction.	None
Species of Special Concern	Temporary displacement of species during construction.	Temporary displacement of species during construction.	None
Socioeconomics			
Population and Housing	Facilitation of the current trend in population growth and new housing.	Facilitation of the current trend in population growth and new housing.	Slowing of population growth with decline in quality of life, discourage in-migration and encourage out-migration of residents and businesses.
Economic Activity	Provide temporary employment during construction; facilitate continued expansion of area economy.	Provide temporary employment during construction; facilitate continued expansion of area economy.	As water shortages become common, water prices would rise and discourage future business expansion or relocation.
Public Services	Temporary increase in traffic density on rura roads in Sedgwick and Harvey counties, as well as city streets in the vicinity of the Local Well Field.	Temporary increase in traffic density on rura roads in Sedgwick and Harvey counties, as well as city streets in the vicinity of the Local Well Field.	Limited water supplies resulting in population and economic decline could limit local tax revenues for public services.
Environmental Justice	None	None	None
Cultural Resources	No known site would impacted; unknown sites would be avoided	No known site would impacted; unknown sites would be avoided	None
Visual Resources	Increase of structures to landscape and creation of night lighting in area of pre-sedimentation plant.	Increase of structures to landscape and creation of night lighting in area of pre-sedimentation plant.	None
Recreational Resources	More consistent lake levels in Cheney Reservoir provide for better recreational opportunities.	More consistent lake levels in Cheney Reservoir provide for better recreational opportunities.	Lower lake levels would limit use of recreational activities at Cheney Reservoir.