Collector Well Projects – Two Page Questionnaire

Thank you for taking the time to help us in this effort to educate interested parties about collector well projects throughout the United States. **A copy of this report will be provided to you within a couple months time.** Please include references to reports or other documents regarding your project in Question C.2.

A. General Project Information

1. Name of project? CEDAR RAPIDS, IOWA COLLECTOR WELLS
2. [illegible]

S.ORG

2402

3. F[illegible]
4. P[illegible] location?
   City/State: CEDAR RAPIDS, IA
5. Project start date?
   mm/dd/yy: SEE ATTACHMENT
6. When did wells begin operating (or anticipated start)?
   mm/dd/yy: SEE ATTACHMENTS
7. Project objective(s)?
   - ☑ Municipal water supply
   - ☐ Agricultural water supply
   - ☐ Conjunctive groundwater/surface water use
   - ☐ Others (please list)
8. Status of project? SEE ATTACHMENTS
   4 CWS IN SERVICE
   2 CWS UNDER DESIGN
   - ☐ Planning
   - ☐ Small-Scale Testing
   - ☐ Large-Scale Testing
   - ☐ Full-scale operation
   - ☐ Other (please explain)
9. Project funding source(s)?
   - ☑ Agency/owner out of pocket expense
   - ☐ Grant funds
   - ☐ Partnerships
   - ☐ Other (please list)
10. What was the primary reason for using collector well technology at this site?
    - ☑ Environmental concerns
    - ☐ Water demand too great for ordinary production well
    - ☐ Water rights for a surface supply not available
    - ☐ Research
    - Other: (1) ENHANCED O+M VERSUS (2) VERTICAL WELLS CAPACITY
11. Number of collector wells and periods of use (seasonal, year-round)? Check boxes that apply. SEE ATTACH

Well Name	Well Status		Use		Average Flow Production (gpm)
	Active	Proposed	Seasonal	Year-Round	
1	✓				
2	✓				
3	✓				
4	✓				

12. Describe the characteristics of your collector wells. SEE ATTACHMENTS

Well Name	Depth of Caisson	Diameter of Caisson	Depth of Laterals	Number of Laterals	Diameter of Laterals

13. Have you observed decreased flow from your collector wells over time? If so, what do you think is the cause?
    - ☐ River migration away from well (please report approximate distance river has migrated: ________ft)
    - ☑ Laterals clogging
    - ☐ Increased pumping from wells nearby (lowered groundwater elevation)
    - Other: WATER PRODUCTION DOES DECLINE W/ AGE + HRS OF OPERATION. PRIMARY FACTORS ARE WATER TEMPERATURE + RIVER LEVEL
14. What measures have you taken, if any, to increase yield of your wells?
    - ☑ Well re-development
    - ☐ Lateral replacement
    - ☐ Added new laterals to existing system
    - Other:

15. Do you have records indicating well yield with time?
   - ☐ No records available
   - ☑ Yes (please fill in the following table)

WELL PRODUCTION VARIES WITH: A) WATER TEMP. B) RIVER LEVEL

	Date	Event	Yield (indicate units)
0	Before operation	Designed capacity	
1		Well start-up	
2			
3			
4			
5		Most recent data	

PRODUCTION ALSO INCREASES AFTER FLOODING/SCOURING EVENTS

16. What is the cost of your raw water (how much does it cost per unit volume for you to produce untreated water)?
   SEE ATTACHMENT
   - ☑ Number provided includes treatment costs
   - ☐ No records available

B. Aquifer Characterization

1. Describe regional aquifer characteristics.
   - ☐ Unconfined
   - ☐ Semi-confined
   - ☐ Confined
   - ☐ Unknown
   - ☐ Other (please list) ________

2. Describe aquifer geology.
   - ☐ Cobble
   - ☑ Gravel
   - ☑ Sand
   - ☐ Silt/Clay
   - ☐ Unknown
   - ☐ Other (please list)
   - ☐ Well Sorted
   - ☐ Poorly Sorted

3. What is the closest distance to the nearest surface water body?
   Feet or miles: ≈100' to ≈300'
   - ☐ Unknown

4. What is the number of monitoring wells if any?
   ____ wells
   CITY HAS 4 WELLFIELDS
   4 COLLECTOR WELLS
   45 ACTIVE VERTICAL WELLS
   8 INACTIVE " "
   NUMEROUS MONITORING W
   - ☐ None
   - ☐ Other
   - ☐ Unknown

5. What is the frequency of groundwater level monitoring?
   minutes/days/months: CONTINUOUS
   - ☐ Unknown

C. Additional Questions

1. Do you have records indicating changes in yield upon re-development? How often do you re-develop your wells?
   SEE ATTACHMENTS COLLECTOR WELLS #1 + #2 WERE PLACED IN SERVICE OCT. 1995 + REHABILITATED IN 2004 POST REHABILITATION CAPACITIES WERE EQUAL to + POSSIBLY HIGHER THAN ORIGINAL CAPACITIES (199

2. Are any reports, technical memos, or other documentation available from your project activities? If so, who do we contact for copies?
   REHABILITATION WORK WAS COMPLETED BY COLLECTOR WELLS INTERNATIONAL, INC COLUMBUS OHIO

TABLE 1
HORIZONTAL COLLECTOR WELL No. 3 AS BUILT DESIGN
CITY OF CEDAR RAPIDS, IOWA

AQUIFER

Top of Aquifer	716 feet
Base of Aquifer	657 feet
Transmissivity at 56°F	200,000 gpd/ft

CAISSON DESIGN

Approximate Grade Elevation	721.0 feet MSL
Inside Diameter Caisson	16 feet
Outside Diameter Caisson	19 feet
Elevation Top of Caisson	733.4 feet MSL
Elevation Top of Plug	664.0 feet MSL
Elevation of Final Floor	664.5 feet MSL
Caisson Depth (from top of caisson to top of floor)	68.9 feet
Thickness Concrete Plug	4 feet
Elevation Centerline Laterals and Valves	667.3 feet MSL
Minimum Recommended Pumping Level	677.3 feet MSL

LATERAL SCREEN DESIGN

LATERAL NUMBER	SCREEN LENGTH (FEET)	BLANK LENGTH (FEET)	LATERAL LENGTH (FEET)
1	102	8	110
3	164	8	172
4	140	8	148
5	140	8	148
6	182	8	190
TOTAL	728	40	768

SCREEN MATERIAL: 12.75-inch OD, 12-inch ID, Type 304 Wire-Wound Stainless Steel (wire width 0.13-inch)

SCREEN SLOT SIZE PLACEMENT (feet from inside caisson wall)

LATERAL NUMBER	SCREEN SLOT SIZE (INCHES)				
	0.040	0.060	0.080	0.100	0.125
1		8-38, 68-78	38-48, 58-68, 78-110	48-58	
3	112-132	68-88, 102-112 132-142	8-68, 88-102, 142-172		
4			8-38, 78-148	38-78	
5		8-18	18-98	98-148	
6	28-48, 78-88	8-28, 48-58, 68-78 88-118, 160-190	58-68, 118-160		
TOTAL LENGTH	50 FEET	190 FEET	388 FEET	100 FEET	0 FEET

TOTAL SCREEN OPEN AREA (Adjusted for couplings and blank sections) .... 831 ft^2

TABLE 2
HORIZONTAL COLLECTOR WELL No. 4 AS BUILT DESIGN
CITY OF CEDAR RAPIDS, IOWA

AQUIFER

Top of Aquifer .... 714 feet
Base of Aquifer .... 655 feet
Transmissivity at 60°F .... 250,000 gpd/ft

CAISSON DESIGN

Approximate Grade Elevation .... 720.4 feet MSL
Inside Diameter Caisson .... 16 feet
Outside Diameter Caisson .... 19 feet
Elevation Top of Caisson .... 733.2 feet MSL
Elevation Top of Plug .... 660.0 feet MSL
Elevation of Final Floor .... 660.4 feet MSL
Caisson Depth (from top of caisson to top of floor) .... 78.2 feet
Thickness Concrete Plug .... 4 feet
Elevation Centerline Laterals and Valves .... 663.5 feet MSL
Minimum Recommended Pumping Level .... 673.5 feet MSL

LATERAL SCREEN DESIGN

LATERAL NUMBER	SCREEN LENGTH (FEET)	BLANK LENGTH (FEET)	LATERAL LENGTH (FEET)
1	194	8	202
3	140	8	148
4	142	8	150
6	194	8	202
7	124	8	132
TOTAL	794	40	834

SCREEN MATERIAL: 12.75-inch OD, 12-inch ID, Type 304 Wire-Wound Stainless Steel (wire width 0.13-inch)

SCREEN SLOT SIZE PLACEMENT (feet from inside caisson wall)

LATERAL NUMBER	SCREEN SLOT SIZE (INCHES)				
	0.040	0.060	0.080	0.100	0.125
1	38-58, 118-138	8-38, 58-78, 108-118, 138-148	78-108, 148-158, 188-202	158-188	
3			8-48	48-148	
4	78-98	8-58	58-78, 98-128	128-150	
6	8-18	18-38	38-88, 188-202	88-98, 118-188	98-118
7	8-38	38-78	78-88	88-132	
TOTAL LENGTH	100 FEET	180 FEET	218 FEET	276 FEET	20 FEET

TOTAL SCREEN OPEN AREA (Adjusted for couplings and blank sections) .... 928 ft^2

a little over half of the total flow. Lateral 7, which is pointing away from the river, was producing the smallest portion of the total flow and had the coldest water temperature.

Sand content tests were conducted during the multiple-rate test and the constant-rate test. The results of these tests are presented in Appendix E. The average of calculated sand content of the water produced from the collector during the multiple-rate test was 0.6 ppm. The average of the calculated sand content of the water produced from the collector during the constant-rate test was 0.2 ppm. The temperature of the collector discharge was approximately 55.5° F at the start of the constant-rate test and dropped to about 53.0° F by the end of the constant-rate test pumping period. The temperature in the River was just above freezing.

6.0 SUMMARY AND RECOMMENDATIONS

Collector Wells International, Inc., under contract to the City of Cedar Rapids, Iowa has completed the caisson and lateral installation and performance testing of two horizontal collector wells (HCW-3 and HCW-4), which are to provide up to 19 MGD of potable water. The source of this supply is ground water derived from an alluvial aquifer along the Cedar River.

Both new collectors were constructed with 16-foot ID concrete caissons and 12-inch diameter laterals. The HCW-3 caisson is 68.8 feet deep (from top of caisson to the top of the final floor). HCW-3 is equipped with 5 laterals ranging in length from 110 to 190 feet with a total lateral footage of 768 feet and a total of 728 feet of screen. Screen open area in HCW-3 is 831 square feet, allowing a low entrance velocity (2.0 fpm) when pumping at the maximum design rate of 6,000 gpm. The HCW-4 caisson is 72.8 feet deep and is equipped with 5 laterals ranging in length from 148 to 202 feet with a total lateral footage of 834 feet and a total of 794 feet of screen. Screen open area is 928 square feet, allowing a low entrance velocity (1.9 fpm) when pumping at the maximum design rate of 7,000 gpm.

CWI conducted performance testing of the new collector wells to determine the installed capacity. The performance testing for HCW-3 was conducted in March 2002, and the performance testing for HCW-

4 was conducted in January 2002. This testing was comprised of an 8-hour multiple-rate step test and a 3-day constant-rate test on each of the new collector wells. During the testing, water level and pumping data and other information were collected at pertinent intervals to evaluate the efficiency and productivity of the new collector wells.

The HCW-3 multiple-rate test was successfully completed on March 11, 2002; during which the well was pumped increasing rates of 4000, 5000, 6000 and 7500 gpm, with each rate held constant for at least two hours. Observed drawdowns in the collector well at the end of the steps ranged from 6.9 feet at 4000 gpm to 13.3 feet at the highest rate of 7500 gpm.

The HCW-4 multiple-rate test was successfully completed on January 29, 2002; during which the well was pumped increasing rates of 4200, 5600, 7000 and 8750 gpm, with each rate held constant for at least two hours. Observed drawdowns in the collector well at the end of the steps ranged from 5.5 feet at 4200 gpm to 13.6 feet at the highest rate of 8750 gpm.

The HCW-3 constant-rate test was started on March 12, 2002. Pumping was continued at 6000 gpm until March 15, with recovery monitored until March 16. During the test, the observed maximum drawdown in the collector was about 15.6 feet.

The HCW-4 constant-rate test pumping was started on January 30 and continued until February 2, 2002, with recovery monitored until February 3. During the test, the observed maximum drawdown in the collector was about 27.0 feet with a pumping rate of at 8750 gpm.

Sand content measurements were made during the multiple-rate tests and the constant rate tests. All of the measured sand content values from the water produced from both of the new collector wells were below the specified limit of 2 ppm.

The results of the testing of both of the new collector wells are favorable. The new collector wells should provide the City with an efficient, dependable source of potable water. Analysis of the testing results for HCW-3 indicates that the collector can yield 6000 gpm under the test conditions with a projected drawdown of about 20 feet, which would place the pumping level about 20 feet above the centerline of laterals. Analysis of the testing results for HCW-4 indicates that the collector could yield about 8200 gpm under the test conditions with a projected drawdown of about 35 feet, which would place the pumping level about 10 feet above the centerline of laterals. Based on the analysis of the testing results, both of the new collectors have initial capacities that exceed the design capacities under the specified conditions.

It is recommended that once the wells become operational, a record keeping program be initiated to collect such essential data as: (1) Pumping Rates, (2) Pumping levels in the collector wells and observation wells, (3) Static water levels in the collectors and observation wells elevations, (4) water temperature of the pumped water and River and (5) Cedar River level. Initially this information should be collected every two weeks and reviewed on a 6-month basis by a person experienced in the analysis and evaluation of this type of operational data. This program will provide current and accurate determination of the operating trend of the Collectors enabling the tracking of the efficiency and yield potential of the wells. This will allow future maintenance requirements to be easily assessed and scheduled at opportune times.

7.0 REFERENCES

American Society For Testing and Materials (ASTM), 2001. ASTM Designation D 5716-95 (Reapproved 2000) Standard Test Method for Measuring the Rate of Well Discharge by Circular Orifice Weir, *Annual Book of ASTM Standards, pages 1407-1410.*

Bruin, J. and H. E. Hudson, Jr., 1955. Selected Methods for Pump Test Analysis, Illinois State Water Survey, Report of Investigations, No. 25.

Hydro Group, Inc., 1995. Hydrogeologic Evaluation, Manhattan-Robbins Lake Park Site, Consultants Report Prepared for the City of Cedar Rapids, Iowa, Prepared by The Ranney Division, Hydro Group, Inc., Westerville, Ohio.

International Water Consultants, Inc. (IWC), March 23, 2000. Letter report to Mr. John D. North, City of Cedar Rapids Water Department, from Mr. Samuel M. Stowe, International Water Consultants, Inc. Regarding: Preliminary Horizontal Collector Well Feasibility Seminole Valley Park Wellfield.