MEMO

TO: Bill Carr, Mayor
Aurora City Council
FROM: Ed Sigurdson, PE, City Engineer (EAS)
SUBJECT: **Water & Sewer Systems Capacity Report – Remaining Potential for Continued Growth within Key Elements of the Aurora Water and Wastewater Facilities**
DATE: Draft October 24, 2005 (Final 12-12-05)
COPY: Laurie Boyce, City Recorder
Ricky Sellers – Public Works
John Rankin, City Planner/Attorney

Executive Summary

This report was prepared at the request of the City to review the capacity of the wastewater and water systems to accept continued population growth. Over the past 5 years the city has grown by 215 people (77 new homes), a growth rate of 32.8 percent for the period or 6.6 percent per year. In addition, development projects have been approved that will permit another 92 homes (258 people) to be constructed over the next few years of build-out. To date, lots have been developed or approved for development that will add 169 housing units or 473 new people. This will increase the residential population from 655 to 1128 over 8 years (72 percent). Considering commercial, industrial and vacancies, this report projects the year 2008 population at 1,214.

Late this summer, the Public Works staff conducted a house by house census to determine the actual population of the city. This study shows the current population of Aurora to be 870 people (per EAS analysis in text below). The existing population plus approved new homes, existing vacancies, normal infill within the city limits and the population equivalent of existing businesses will yield a build-out equivalent population of 1,214 by the projected build-out year of 2008. This figure is used throughout this report to determine the load on the water and sewer system from existing and known upcoming growth. The report then looks at the available capacity of these systems to see if added growth can be accommodated without significant expansion, and if so, how much.

Wastewater System

Prior to the year 2000, Aurora growth was limited by not having a sewer system. The new wastewater system was constructed from 1999 through early 2001. It has been operating for approximately 5 years. This system was designed by BST Engineering to serve the wastewater discharge of the existing city as of the year 2000 plus a growth of approximately 61 percent over a 16 year planning period. It is the finding of this report that actual growth is occurring at a rate much faster than was planned by the design engineer but the initial wastewater loading to the system has been much lower than was anticipated in his design. To quantify this generality, the report addresses each aspect of the wastewater system to determine what demands are currently being placed on it from the existing population, and how the new loadings from growth will impact each key

element of the system. This yields the amount of growth each element can assimilate before it reaches capacity. Following is a brief summary of these findings:

- **Population** – The original design engineer used population analysis in his predesign report to help size the system but did not use it in the final design criteria listed on the first page of the construction drawings for the wastewater plant. The wastewater treatment plant will be impacted by growth much more than the collection system. The plant was designed to receive, treat and discharge a specific volume and strength of wastewater. Because of the way DEQ regulates the treatment plant, this report focuses on the ability of the system to process, treat and discharge wastewater rather than using population as the basis of determining plant capacity. Once the plants capacities are determined, they are related back to population to permit the City Council to address issues of growth.
  - **Initial population at year 2000 system startup** – The official Federal 2000 census was 655. The initial design population for the plant is not clear but is likely between 655 and 680 (initial design population is the number of people the plant was designed to serve when it initially went into service in 2000.
  - **Ultimate Design Population** – Again, the ultimate design population for which the plant was sized is not stated by the engineer but my best estimate of his intent is 1,052, working from the earlier predesign study which was subsequently modified several times during design. This population was to generate a volume of wastewater that will require the treatment plant or collection to be expanded before more growth could be accepted. It was my finding that Aurora generates much less wastewater per person than was anticipated by the engineer. This loading level is not expected to change as the city grows unless businesses or industry is added that has a high wastewater loading. If the existing balance of housing, business and industry continues into the future, the system will be able to serve the needs of many more people than would be indicated by the above population projection. Actual projections are provided in this report.
  - **Actual Population Capacity of the system** – The report makes population projections for various elements of the system as the report works through them. In general:
    - **Collection System** - The collection system has the capacity to handle growth without significant upgrade to well over 2,000 people, most elements, considerably above this figure. (The collection system is the sewer pipes throughout the city and related pump stations)
    - **Treatment Plant** – In general, this study projects that the plant will be able to stay within the permit requirements of DEQ if the population increases to between 1,600 and 1,800 people. At that population, a significant expansion of the plant appears to be required. Detail is in the report.
- **Collection System**
  - **Gravity Collection System** – The 8-inch gravity system (8-inch pipes) throughout the city has a flow capacity to meet the needs of over 3,000 people without upsizing. The pipes and manholes have proven to be bottle tight and do not let in ground water during the winter. This fact alone has a

huge impact on the design of the treatment plant, which was designed for a moderate amount of pipe leakage. Five years experience with this system has shown no increase in leakage flow what-so-ever. I project no significant leakage concern for the 20-year planning period.

- **Pump Stations** – The four pump stations in the system are all easily handling the flows coming to them. Because the system design engineer assumed pipe leakage, each pump station is designed to handle about 2.5 times its normal flow during storm events. The system is seeing almost no increase at all with rainfall events. This provides a huge capacity buffer for growth. When the system went on line in 2001, the main pump station was found to be capable of pumping only about 15 to 20 percent of its design capacity. This was due to an error in the specifications. The pumps have since been replaced and this station is now performing properly. If any of the stations need more capacity in the future, it is relatively inexpensive to replace the pumps with larger ones.
- **Force Mains** – Each pump station discharges into a force main the carries the wastewater to a point where it can flow by gravity. Most of the force mains in the system are quite long. The sizing of each will permit pump upsizing in the future when needed without replacing the force main pipe. If city growth is reduced to a more manageable level in the future, The force mains appear to be adequate to meet the city's needs over the planning period, with the possible exception of major growth in northwest Aurora.

- **Treatment Plant**
  - **General** - The treatment plant is made up of an aeration lagoon, a storage lagoon, a treatment plant building, three pump stations, instrumentation, irrigation effluent filter, chlorination system, dechlorination system, and irrigation system. Each of these elements have finite capacity for receiving and processing sewage. The limitation of the plant is the weak link among these components.
  - **Purpose of Plant** – The treatment was constructed primarily to remove pollutants from the wastewater before it is discharged.
  - **Effluent Disposal** - In the winter, the effluent from the plant is pumped to the Pudding River at the foot of 4th Street. In the summer, the effluent is irrigated to a 6.7 acre poplar plantation at the plant site.
  - **Regulations Controlling Discharge** – The plant is sized to be able to discharge effluent within the specific requirements contained in a permit issued every 5 years by DEQ (NPDES Permit). Discharges in violation of this permit will make the city subject to fines and even mandatory construction projects to correct a problem that causes repeated violations.
  - **Purpose of Design** – The engineers design is to allow the city to discharge effluent from its plant in a manner that will not violate the discharge permit. It also is to provide an efficient and economic way to treat the wastewater.
  - **How have we been doing?** – The plant has been doing an excellent job of treating the wastewater generated by the community. It appears to be capable of easily staying within permit under normal operations, and, so far,

has been flexible to handle unusual situations that come up. The quality of treatment from this simple aerated lagoon plant is equal to or better than most of the large high-tech mechanical plants constructed by most other cities. The plant is not stressed by current wastewater loadings and has considerable capacity for growth, with one exception that gives me some concern which will be detailed below.

- **Flow to plant** – At current percapita flows, the treatment plant will not reach its design capacity until the population reaches 1,536 people (322 people beyond build-out of approved lots). With a detailed facility plan study by a sanitary engineer, it is likely the plant can be adjusted to handle a flow greater than would be generated by this population (approaching 2,000 people), but I can not recommend growth to that level.
- **Removal of organic material from sewage** – The plant is designed to remove 181 pounds of BOD and TSS form the incoming sewage each day. The current loading of BOD to the plant is 73 pounds. At the current loading rate, the plant is capable meeting the BOD needs of 2,175 people (961 beyond build-out).
- **Removal of inorganic material from sewage** – The plant is currently being loaded at 100 pounds per day. This allows growth of 81 more pounds or a population of 1,582, which is 368 more than build-out.
- **Effluent quality in discharge to the river** – Currently there has been no measurable BOD discharge to the river in the past two years. TSS loading are extremely low, even with high volume discharges only 1 to 1.5 weeks per month. I project the plant can handle the influent form 1,800 people before either BOD or TSS will be a concern and even then, careful discharge could extend this plant life.
- **Aerated Lagoon** – This lagoon will receive a new headworks within the next few weeks. When this is done and the existing sludge is removed, it will be possible to greatly improve the aeration in this lagoon (currently rags in the sewage is damaging the aerators keeping one or more out of services at all times). Aeration translates to removal of BOD from the sewage. Once again, this facility will meet the needs of a population of approximately 1,600 people before its capacity is stressed. It may be possible to increase this capacity with relatively minor modifications. BOD removal is critical at this plant. TSS is not as great a concern as effluent filtration can remove it from the effluent in the future when the plant is expanded.
- **Holding Lagoon** – This large lagoon collects and stores any sludge that escapes the aeration lagoon (designed for up to one million gallons of sludge) but mostly it is to store effluent until the operator wishes or is able to discharge it to either the river or to irrigation. It is sized to an influent flow of 87,000 gpd. This is a population of approximately 1,538 under current conditions. This capacity will permit the storage of nearly 3 months of influent, without discharge, at design flow. This permits the operator to deal with unusual weather conditions when he can not discharge to the river due to low river flow

or when he can not irrigate due to excessive rainfall during the irrigation season. This year all these factors may be coming together in one year that may cause the operator to discharge outside the permit (if we do not get enough fall rain to bring up the river flows by or shortly after November 1st). Actually, this bullet was dodged as discharge was permitted on November and more than adequate storage was available.

- **Irrigation** – The existing irrigation plantation has experienced problems this year with ground saturation. I recommend plug aeration of the plantation to open the soil to effluent plus initiation of a project within the next year to locate additional land for irritation, then proceed to acquire and develop it.

- **Wastewater Summary**
  - **Collection System** - The collection system is projected to meet the needs of the growth to a population of 2,000 or beyond.
  - **Treatment Plant** – This report says the treatment plant can receive and treat the wastewater from a population of approximate 1,540 before any element reaches capacity. This is tempered somewhat by the need for additional irrigation, however careful irrigation management will permit the system to function with increasing flows unless extreme weather conditions accumulate to cause discharge violations. DEQ often will allow discharge outside the permit under these extreme conditions.
  - **Recommended Actions**
    - **Growth** – It is my opinion that the wastewater system can meet the needs of 1,540 people without significant expansion. This allows growth of only 326 new people (beyond approved land development projects) before the plant reaches a point where the potential exists for violations of the discharge permit. I further recommend that a buffer of 15 percent be applied to prevent population growth from reaching the above figure before an expansion plan is complete and any needed construction project to expand the plant is funded. The 15 percent buffer is 231 people leaving 95 people to be considered for annexation projects. At 2.8 people per lot, this is 34 lots. Infill projects must continue as the city has no way to prevent them. Infill projects can be applied to the 15 percent buffer.

      It is likely the growth beyond this population (1,540) will be possible by construction of relatively inexpensive projects to improve the efficiency of the treatment process. Hydraulically the plant can handle much more wastewater than would be produced by the population above.
    - **Headworks** - Complete purchase and installation of new headworks is budgeted.
    - **Sludge** – Removal or all sludge from the aeration lagoon after headworks completed is budgeted.

- **Treatment Plant Study** – I recommend the City initiate a wastewater system facilities plan within the next 12 to 18 months – Cost $60,000 to $80,000. This work would be handled by another consultant that could be selected under my City Engineer agreement or they can be hired directly by the city under a request for proposal.
- **Irrigation Expansion** - Initiate a program to expand the irrigation plantation to add capacity and flexibility for operator during unusual weather conditions. It is likely any new plan for expansion will include expanded irrigation as this will become a bottleneck at flows expand beyond the design flow.

Water System

The Aurora water system has been stressed over the past two summers with supply not able to keep up with the increasing demand. To ease this problem, G Cam Limited has drilled a new well and is currently adding the pump, well house and related items to make the well fully functional. This well will increase the peak summer water supply from about 150,000 gallons per day to over 360,000 gallons per day. The normal summer water supply should be well over 400,000 gpd. This increase however could be greatly reduced by a pent up water demand during the summer if people are no longer requested to conserve water during the summer.

- **Population served by new water supply** – The report indicates that the new water supply will meet the needs of the city at build-out of approved lots plus an additional 526 people, or a total population of 1,740 (conservative estimate). At that population, the city may again need to aggressively request users to conserve water during the summer month. As growth approaches 2,000 people some type of required odd-even system may be required. With added reservoir capacity and a mandatory conservation program, it is possible to provide water to a city of 3,200 with a water supply of 400,000 gallons per day under extreme restrictions and low commercial/industrial demand. This report will consider this supply appropriate for 1,740 people before a new supply is required. It is possible the groundwater supply may decrease over time. If this occurs, the additional supply may be needed before the population reaches this level. Predicting future loss of supply is extremely difficult. The city should carefully monitor the supply over time to determine if a loss of supply is occurring. If so, the process of acquiring new water rights and a suitable well site should be accelerated.
- **Water System Needs**
    - **Reservoir** – The new reservoir that was planned to be constructed last summer was delayed and funds shifted to the new well. This reservoir project remains at the top of the list of water system needs and should be funded and constructed at the earliest possible time.
    - **Northwest Aurora Reservoir** – A third reservoir is needed in northwest Aurora. The existing 1996 master plan located it near the existing city limts off Airport Road. This project will be critical if planning proceeds for expansion of city services toward the Airport.
    - **Major Distribution system improvements** – A large diameter loop line (10 or 12 inch is recommended for Highway 99E to provide a looped system for

the city. This line will grow in importance if business or industry expands along the Highway 99E corridor or in the downtown area.

- **Other Distribution system improvements** – An ongoing program is needed to replace the undersized and outdated lines that make up the bulk of the distribution system. The new line on Liberty Street has resolved the serious supply problem throughout the city but most of the remaining lines are in poor condition and are typically greatly undersized to supply fire flows. A systematic line replacement program is recommended in this report.
- **Well** – Another new well will be needed in 5 to 15 years depending on the continued growth rate of the city and the continued strength of the existing aquifer that supplies the existing wells.
- **Pumping and controls** – The city is currently investing in a telemetry and control upgrade of the water pumping station. Reservoir construction may require further modifications or addition of new facilities if it is not located near the existing reservoir and pump station.
- **Water Conservation** – An active and aggressive conservation program has been mandated to all cities by the State. This type of program will greatly extend the life of the new well by reducing withdrawal from the aquifer and is strongly recommended in this report.

- **Water Planning** –Planning for this well should begin within the next 12 months. Planning items:
  - **Water Rights** – Most of the city's available water rights have been used with the new well currently being put on line. Any additional new wells will require new water rights. Water rights are not readily available and have become quite valuable. Several years of lead time is typically required to acquire rights and gain state approval for a new well.
  - **Well Location** – Finding a suitable location to drill a new well will depend somewhat on the type of water rights acquired. If both surface and ground water rights are acquired, it may be possible to site a well within ¼ mile of a river which opens up much more land in Aurora, which is surrounded by rivers on three sides.
  - **Funding** – The city has a systems development charge for water. This should be revisited in the near future by a financial analyst specializing in SDC's to develop a funding package for all planned water projects. This package should include user rate funding.

Wastewater, Water System Growth Capacity Study

At the Mayor's request, on April 12, 2005 I provided a memorandum discussing the remaining life of the various Public Works facilities before significant expansions are required to permit continued growth of the City. Since that time, concern has continued about the ability of wastewater and water system to support continued annexation and development of land to the City. The earlier memo addressed this subject using available data and records that existed at that time. In the interim, additional data has been collected. This updated report will utilize this improved data base to focus on the available remaining capacity of key elements of the water and wastewater systems.

POPULATION AND RECENT GROWTH

Since the earlier study, the Public Works staff has conducted a door to door survey of the existing population of Aurora. The results of this survey was published by the staff and is presented in the appendix of this memo report. These results are summarized on **Table 1, Population Summary**. The staff survey is presented in more detail by street on **Table 2**. A correction was made to the staff data as Albers Court population was counted in both Albers Court and Kasel Court data. **Table 3** provides an analysis of population gain from land development projects between 2000 and the present time. Adding the lots created and developed for land development projects to the official 2000 census yields the same total population figures found in the PW population survey, 870 people.

In analyzing the population data developed, the following findings were generated:

Population Findings

- **Population** - The current population of the City of Aurora is **870**.
- **Rate of Increase** – The population increased by 215 people in the five years since the 2000 census which is a 32.8 percent population increase. This is a simple 6.6 percent per year growth rate. This rate of population growth has been higher in the past three years than the first two years due to development start-up time. Growth over the past three years has exceeded 10 percent per year. This rapid population growth is the result of pent up demand held back by the lack of a sewer system. This demand will continue well into the future baring a major change in the economy of the state.
- **People per home** – The 2000 census showed 2.53 people per unit. This overall total has increased to 2.66 in the past 5 years. This shows the new homes being construction are averaging at or slightly above 2.8 people per home.
- **Approved building sites** – Land development approvals over the past 5 years has created an additional 92 lots which were not yet completed and occupied. Using 2.8 people per unit (the approximate average people per unit for new homes being constructed) 92 lots will generate an additional 258 people at build-out. Build-out for these lots can be expected to be complete in approximately 3.5 years.
- **Vacant homes** – The 2000 census shows 12 units in Aurora vacant at that time. Although not all vacancies were flagged in the staff census, Aurora has a continuing vacancy rate in housing units.

- **Year 2008 Build-out Population Projection** – Following is the basis for projection of population to build-out of existing and approved building lots with a small allowance for continued infill of 2 units per year. This projection on Table 3 is summarized:

  - 2005 population - 870
  - 3.5 year build-out of 92 available lots (2008) 258
  - Occupancy of vacant homes – 33
  - Normal infill at 2 units/year (3 x 2 x 2.8) - 17
  - Population impact of businesses (120 x 0.3) - 36
  - Total maximum population in year 2008 - 1,214

  The above projections represent an increase of population in Aurora of 85 percent in 8 years or a simple growth rate of 10.7 percent per year. This continued growth rate is dependent on the housing market remaining as it is now and a very low vacancy rate. It is however, quite possible that infill subdivisions could create more than 2 lots per year (6 lots over next three years). This may be offset by continued vacancies such that the 6 infill lots could be increased to 18 lots without impacting the projected year 2008 population of 1,214.

- **Business and Industry** – The staff census identified a total of 120 jobs in 57 businesses and industries within the Aurora city limits. Most of these are very small businesses as they average approximately 2 employees per business. It also identified a large number of vacant businesses which would be filled with a stronger business climate in Aurora. A growing population base will, over time, help to stabilize the business sector. Aurora has relied on the historic theme of the town for most of its businesses. This market has softened in recent years. Efforts are underway for continued downtown revitalization. More diversification to meet the needs of the new residents may help this process. Larger businesses and more industry will greatly stabilize the business base plus the finances of the city. In attracting business and industry, it is critical that they do not have a heavy water demand or wastewater loading. As will be shown below, both these systems have limited capacity for added growth without significant expansion.

WASTEWATER SYSTEM

General

Prior to the design of Aurora's new wastewater system, a predesign report was prepared by the consulting firm of BST Engineering. The 1998 predesign study is the only document found in the records that studies the Aurora wastewater system. At that time, Aurora had no central wastewater system and homes and businesses were served by septic tanks and drain fields. No facilities plan was completed prior to the predesign study, as there was no sewer system to study. The predesign study was reviewed by the city and DEQ. Following the review, construction plans and specifications were drawn and the system was constructed by a combination of contractor and local citizen self-help effort. BST Engineering completed the planning, design and construction inspection for the system.

Table 1

CITY OF AURORA

POPULATION SUMMARY

	2000 Census Data	*2005 PW Data*	*Increase*	*% Increase*	*Annual % Increase*
Population	655	870	215	32.8	6.6
Households	250	327			
Total housing units	262	327			
Vacant housing units	12				
Owner occupied units	212				
Rental occupied units	38				
Average household size	2.53	2.66			
Ave. renter occupied size	3.11				

Table 2

CITY OF AURORA
POPULATION ANALYSIS

ANALYSIS OF PUBLIC WORKS POPULATION SURVEY

Street	*No. Housing units*	*Population*	*People/unit*	*Business Employees*	*Notes*
Airport Road	11	36	3.27	0	
Albers Way	11	27	2.45	0	
Bob's Avenue	11	28	2.55	0	
Cody Lane	13	28	2.15	0	1-not yet occupied
Ehlen Road	6	18	3.00	0	
Esperanto	2	6	3.00	0	
Filbert	41	115	2.80	0	
First	0	0	0.00	10	
Forth	3	8	2.67	0	
Highway 99E	18	45	2.50	46	
Jannymarie Lane	3	7	2.33	0	+3-vacant lots
Kasel Court	17	43	2.53	0	
Liberty Street	43	114	2.65	0	
Lloyd's Lane	3	9	3.00	0	
Main Street	41	106	2.59	31	
Orchard Avenue	18	47	2.61	0	
Ottaway Road	17	33	1.94	24	
Park Avenue	15	39	2.60	0	
Sayre Drive	7	18	2.57	0	vacant rental
Second Street	6	21	3.50	7	
Smith Lane	5	11	2.20	0	
Third Street	3	8	2.67	2	
Umbenhower Lane	8	32	4.00	0	
Walnut Street	25	71	2.84	0	
Totals	***327***	***870***	***2.66***	***120***	

Table 3

CITY OF AURORA
POPULATION ANALYSIS

NEW LOT ANALYSIS

New Lots Created Since 2000

Project Name	*Streets Involved*	*Base Dwelling Units*	*Base Population*	*Number of Lots Created*	*Population on New Lots*	*People per unit*	*Unoccupied Lots*	*Totals*
2000 Base (from Census Data)								
	City Wide	250	655			2.53	12	
New Lot Creation								
Orchard View Subd.	Orchard St + Filbert/Walnut			38	104	2.74	1	
Strawberry Acres Subd.	Cody Lane			13	34	2.62	0	
Daria Meadows Subd.	Cody & Ottaway			3	0		3	
Hazelnut Park Subd.	Umbanauer Ln.			11	38	3.45	0	
Beth Heer Partitioning	Jennymarie Ln.			5	8	1.60	3	
Payton Circle Subd.	Unnamed private street of 99E			4	0		4	
Eddy/Halton Partition	Park Ave - off Liberty			1	0		1	
Heid Partition	Off Liberty, N of Bob's			1	0		1	
Keil Park 1	S off Ottaway, W of Liberty			40	0		40	
Keil Park 2	S off Ottaway, E of Main			39	0		39	
Infill Lots developed (estm.)	City Wide			11	31	2.80	0	
New Lot Totals				166	215	2.64	92	

Sum of Base data and Growth

Population - base plus defined growth	655		215			870
Population from PW Census						870
Unoccupied available new lots + unoccupied existing units					104	
Projected population for available lots & units					104*$2.80	291
Projected population at buildout of available lots defined above & no vacant units						1,161
Projected infill at 2 units per year (2 x 3 x 2.8)						17
Impact of Commercial & Industrial Employees & customers			120 empl x 0.3 =			36
(Assumption - Demand/Loading by employee & customers = 0.3 times Resident)						
(Assumption - commercial/industrial demand/loading will not exceed residential rates)						
Equivilant population at build-out of existing approved lots						**1,214**

The predesign report contains design criteria for the wastewater system. The project was then reviewed by the staff and City Council, DEQ and interested citizens. Modifications to the design concepts were made throughout the design process and final design criteria were included at the beginning of the treatment plant construction drawings. These criteria are shown on **Table 4** and will be used in the analysis of the wastewater system that follows.

Wastewater Treatment

Table 5 details the key information from the daily monitoring reports submitted to DEQ monthly. My review findings are presented in outline format to simplify review of the technical information:

- **Design Population**
    - **Predesign Report** – For the design year 2019, a population of 1129 is given however this value was not used in design of plant.
    - **Construction plans** – Design year and design population are not shown under design criteria on the construction drawings but from the data that is available, I computed the design year to be **2016** using my calculated design population of **1,052***

      * This population and year was calculated using a ratio of the flow figures listed in the predesign report compared to the figures for the same flow categories in the design criteria provided on the treatment plant plans. This shows the treatment plant was constructed with less than the normally DEQ required 20 year planning period (approximately 17 years from the first published plan and 15 years from completion of construction).
    - **Initial flow & population** – The predesign report shows the initial plant flow at 57,000 gallons per day (gpd) from a population of 682. The plans show the initial first year flows at 54,000 gpd, average daily flow. Population figures are not provided on the plans but analysis shows a population of 682 was used to generate the projected initial flows of 54,000 gpd. As noted above, the official 2000 census determined Aurora 2000 population to be 655 people. The 2000 census is based on 1999 data so the 682 figure may be quite close for the first year of plant operation in 2000-2001.
    - **Year 2005 Population** – The PW staff census shows the **2005** Aurora population to be **870**. In the study provide last spring, EAS projected the **2004** population to be **848**. This figure was quite accurate based on the new census.
    - **Build-out Population for the Year 2008** - At build-out of approved lots, the population is projected above to be 1,214 in 2008. The build-out projected population in the earlier report last spring was 1,160. The new data has permitted a more accurate projection. This new projection exceeds the estimated wastewater treatment plant design population of 1,052 by 162 people. This population, however, is not projected to exceed the plants ability to treat wastewater within the limits of the DEQ discharge permit.

      As noted in the report last spring, the values used in designing the treatment plant are the projected wastewater flow to the plant plus the treatment loading of the sewage (pollutants within the sewage measured in BOD and TSS). Population apparently was used by the design engineer as the

TABLE 4
City of Aurora
Wastewater Treatment Plant
Design Criteria

	Start-up 2000	*Design ~2016*	**Current 2005**
1. Plant Flows			
ADWWF, gpd	54,000	87,000	45,000
MMWWF, gpd	73,000	118,000	47,000
PMWWF, gpd	95,000	153,000	50,000
MDWWF, gpd	125,000	203,000	56,000
PHWWF, gpd	155,000	251,000	69,000
ADWWF, gpm	38	60	32
PHWWF, gpm	75	122	33
Q gpm (influent pump station - each pump	300	300	
TDH, ft	16	16	
Discharge Size, in.	6	6	
2. Flow Meter			
Capacity, gpm	300	300	
3. Aerated Lagoon Cells			
Detention time	5.8	3.6	6
BOD5 into plant, mg/L	250	250	200
BOD5 out of plant, mg/L (to river)	30	30	0
TKN into plant, mg/L	25	25	
TKN out of plant, mg/L	25	25	
Number of cells	4	4	
Total Dissolved Oxygen, lb O2/d	174	280	
Depth max, ft	10	10	
Total Surface Area, ac	0.23	0.23	
4. Aerated Lagoon - Settling Cell			
Detention time, d	0.8	0.5	0.9
Compartments	2	2	
Depth max, ft	10	10	
Surface area, sf	1,160	1,160	
5. Facultative/Storage Cell			
Solids storage volume, MG	0.96	0.96	
Working water storage volume, MG	7.2	7.2	
Max. effective water surface area, ac	1.72	1.72	
Total depth, ft	21	21	
Max. detention time, d	133	83	140
Total loading, lb BOD5/ac-d (all aerated cells & % other lagoon:	101	162	81
6. Drum Filter			
Flow range, gpm	38 to 165	60 to 260	
Installed screen size, microns	18	18	
Additional screen size, microns	30	30	
Spray Pump, gpm/psi	14.25/100	14.25/100	
Continuous flow, gpm (water balance)	9 to 46	9 to 90	

	Start-up 2000	*Design ~2016*	**Current 2005**
7. 4" Flow Meter (before drum filter)			
Min. Flow for +/- 0.5% accuracy, gpm	60	60	
Accuracy at 38 gpm, +/-%	0.85	0.85	
Max. flow at 30 fps, gpm	1,175	1,175	
8. Chlorine Contact Tank			
30-minute design flow, gpm	260	260	
3-minute design volume, cf	7800	7800	
Working water depth, ft	5	5	
9. River Discharge Duplex Pump Station			
Type	Submersible	Submersible	
Discharge Pumps (ea.), gpm	300	300	
TDH, ft	65	65	
Diameter of wet well, ft	6	6	
Working height, ft (3 minute "on")	4.2	4.2	
10. Poplar Irrigation Simplex Pump Station			
Type	Centrifugal	Centrifugal	
Flow, gpm	125-160	125-160	
TDH, psig	50	50	
Diameter of wet well, ft	6	6	
Working height, ft (5 minute "on")	3.8	3.8	
11. Irrigation Pump Filter			
Flow capacity range, gpm	38 to 165	60 to 260	
Installed screen size, microns	18	18	
Additional screen size, microns	30	30	
Spray Pump, gpm/psi	14.25/100	14.25/100	
Continuous flow, gpm (water balance)	9 to 46	9 to 90	
12. Solids Return Duplex Pump Station			
Type	Submersible	Submersible	
Discharge Pumps (ea.), gpm	34	34	
TDH, ft	27	27	
Diameter of wet well, ft	6	6	
Working height, ft (10 minute "on")	1.6	1.6	
13. Poplar Irrigation Acres			
NW Area, ac	1.5	1.5	
SW Area, ac	5.2	5.2	
Peak flow (both areas), gpm	105	105	

Table 5

CITY OF AURORA

NPDES - DMR SUMMARY

2004-5

NPDES-DMR SUMMARY-2004-5

MONTH	INFLUENT TOTAL MO.	INFLUENT MAX. DAY	INFLUENT AVERAGE	EFFLUENT TOTAL MO.	EFFLUENT MAX. DAY	EFFLUENT AVERAGE	INFLUENT BOD mg/l	INFLUENT LBS BOD lbs.	INFLUENT TSS mg/l	INFLUENT LBS TSS lbs.	PLANT EFFLUENT Discharge River or Irrig.	BOD DATA BOD mg/l	BOD DATA REMOVAL %	BOD DATA DISCHARGED LBS	TSS DATA TSS mg/l	TSS DATA REMOVAL %	TSS DATA DISCHARGED LBS.	RAINFALL IN.
Permit Limits												30	85	126	30	85	126	
2004																		
1	1.308	0.049	0.042	4.006	0.480	0.334	190.0	62.3	143.5	47.5	River	0.0	100.0	0.0	2.0	98.3	5.6	6.14
2	1.162	0.048	0.040	0.000	0.000	0.000	394.0	134.0	360.0	124.0	None	0.0	100.0	0.0	0.0	100.0	0.0	5.29
3	1.272	0.047	0.041	3.550	0.644	0.655	373.0	128.0	470.0	162.0	River	0.0	100.0	0.0	11.0	92.0	32.6	1.43
4	1.284	0.052	0.043	0.000	0.000	0.000	215.0	63.0	310.0	91.0	None	0.0	100.0	0.0	0.0	100.0	0.0	1.12
5	1.328	0.050	0.043	0.882	0.620	0.126	165.0	56.0	230.0	77.6	Irrig.	11.5	95.1	3.8	25.0	95.0	8.4	0.00
6	1.302	0.055	0.043	0.890	0.080	0.059	185.0	60.6	244.0	79.6	Irrig.	8.5	100.0	2.9	27.5	83.0	8.9	1.82
7	1.426	0.054	0.046	0.952	0.090	0.068	187.6	66.2	122.6	44.5	Irrig.	0.0	100.0	0.0	17.0	86.9	6.2	0.12
8	1.420	0.046	0.046	6.340	0.650	0.400	230.0	88.2	350.0	139.5	Irrig.	15.5	100.0	6.0	25.5	93.0	25.5	2.64
9	1.355	0.047	0.045	1.485	0.115	0.083	181.0	66.7	337.5	125.4	Irrig.	4.0	98.8	1.5	44.0	86.8	16.6	1.93
10	1.418	0.056	0.046	1.601	0.114	0.089	83.5	30.4	372.5	139.5	Irrig.	0.0	100.0	0.0	20.0	92.0	7.4	3.90
11	1.410	0.062	0.047	2.422	0.473	0.346	76.0	28.5	96.0	36.0	River	0.0	100.0	0.0	13.0	90.0	37.5	2.06
12	1.503	0.055	0.048	3.501	0.485	0.389	166.7	68.6	389.3	160.4	River	0.0	100.0	0.0	18.0	97.0	58.4	13.10
TOTALS / AVGS	1.349	0.052	0.044	2.136	0.313	0.212	203.9	71.0	285.5	102.2		3.3	99.5	1.2	16.9	92.8	17.3	39.55
Ave. Dry Weather	1.375	0.051	0.045	2.025	0.278	0.138	172.0	61.4	276.1	101.0	Irrig.	6.6	99.0	2.3	26.5	89.5	12.2	10.41
Ave. Wet Weather	1.349	0.052	0.044	2.136	0.313	0.212	203.9	71.0	285.5	102.2	River	0.0	100.0	0.0	11.0	94.3	22.3	29.14
2005																		
1	1.562	0.056	0.050	0.000	0.000	0.000	135.0	52.8	135.5	53.9	None	0.0	100.0	0.0	0.0	100.0	0.0	1.59
2	1.289	0.051	0.046	3.410	0.482	0.379	180.0	68.1	257.5	99.5	River	0.0	100.0	0.0	4.0	97.3	12.6	0.48
3	1.398	0.056	0.045	0.000	0.000	0.000	265.0	105.3	311.5	123.4	None	0.0	100.0	0.0	0.0	100.0	0.0	4.07
4	1.376	0.051	0.046	3.153	0.472	0.350	120.2	44.2	85.0	30.8	River	0.0	100.0	0.0	18.0	80.0	52.5	3.28
5	1.419	0.052	0.046	0.000	0.000	0.000	245.0	93.8	452.0	171.3	None	25.0	100.0	0.0	24.0	100.0	0.0	4.19
6	1.398	0.050	0.047	0.424	0.075	0.061	160.0	59.6	364.0	135.8	Irrig.	26.7	100.0	0.0	15.7	94.8	7.1	1.82
7	1.458	0.052	0.047	1.189	0.103	0.074	117.0	46.6	180.0	71.3	Irrig.	0.0	100.0	0.0	23.0	86.5	9.0	0.51
8	1.450	0.052	0.047	2.005	0.101	0.087	155.0	58.5	210.0	79.1	Irrig.	28.5	81.9	10.6	25.5	88.0	9.5	0.06
9	1.413	0.051	0.047	0.900	0.087	0.064	365.0	143.7	272.5	105.0	Irrig.	24.5	92.0	9.2	25.0	91.0	9.7	2.21
TOTALS / AVGS	1.418	0.052	0.047	1.231	0.147	0.113	193.6	74.7	252.0	96.7		11.6	97.1	2.2	15.0	93.1	11.2	18.21
Ave. Dry Weather	1.428	0.051	0.047	0.904	0.073	0.057	208.4	80.4	295.7	112.5	Irrig.	20.9	94.8	4.0	22.6	92.1	7.1	8.79
Ave. Wet Weather	1.406	0.054	0.047	1.641	0.239	0.182	175.1	67.6	197.4	76.9	River	0.0	100.0	0.0	11.0	88.7	32.6	9.42

beginning point to estimate the flows and loadings, for which the plant was designed but population is not a design criteria for the capacity of the plant. Experience in operating the plant has shown that the engineer's estimates of plant loading per person of population were conservative and actual flows and loadings are much lower than projected. It would appear that the plants capacity will not be exceeded at the 2008 build-out population, however any significant increase in population beyond that amount will require modification of the plant to increase its treatment capacity. This will be presented in more detail below.

It should be noted that the Aurora wastewater system is unique in the state of Oregon. Projecting flows and loadings for it were difficult. The entire wastewater system was constructed from scratch in 1999 and 2000 using modern materials and construction techniques. It therefore receives almost no I&I (inflow and infiltration – ground and storm water finding its way into the sewer pipes) so actual flows are much lower than projected. The sewage load (BOD and TSS) are also lower than the textbook values used in designing the plant because the wastewater is nearly all residential in character. The result of conservatism in the original design has resulted in considerably more plant capacity than would be indicated by the original design population.

- **Analysis of Existing Loadings to the Treatment Plant**

  Although a population analysis shows that the plant should have used up 82 percent of its designed growth capacity by 2005 (870 of 1052), and will exceed its design population based design capacity when the approved lots are built out, the analysis below will look at the actual flows and sewage loadings to the plant to determine how its actual performance is tracking with the original design projections.

  - **Wastewater Flow** –
    - **Design Flow** - The wastewater treatment plant was designed to begin service in the year 2000 with an average annual wet weather influent flow of 54,000 gallons per day (gpd).
    - **Actual 2005 Flow** - In the weather year 2005, actual 12 month average annual flow was 52,000 gpd. This shows that none of the hydraulic growth capacity designed into the plant has been used through September 2005.
    - **Summer/Winter Flows** – Normal Oregon treatment plants have a significant flow increase during the wet winter months. This increase varies from a flow ratio of approximately 1.5 to1 with some plants experiencing a 3 to 1 (or higher) average winter flow compared to the average summer flow. For the past two years, the average flow difference between summer and winter in Aurora was:
      - **2004** – Dry weather 0.045, Wet weather 0.044 (lower winter flow)

- **2005** – Dry weather 0.047, Wet weather 0.047 (same but partial data)
- **Max Day flows** (Highest daily flow for each month averaged over 12 months) - Nearly the same, summer to winter (2004 with latest full year of data – 0.51 dry weather & 0.53 wet weather)

Hydraulic Capacity Findings - These data show that the Aurora wastewater plant, pump stations and piping system is not impacted by high winter rainfall induced flows. Aurora may be the only city in Oregon that can make this statement (or at least one of a very few). The plant hydraulics are designed for 87,000 gpd average daily wet weather flow (6 months of the winter). It is also designed for a peak daily flow of 203,000 gpd for the highest flow day of the year. The highest actual single day flow in the past two years was 62,000 gpd. This shows that the plant is currently operating at only 30 percent of the plants hydraulic capacity. With the loading generated by the current population, the plant will not reach capacity until the population grows to 2,900 people.

All hydraulic aspects of the wastewater system were designed for peak winter storm flow events. As noted above, the wet weather flows to the treatment plant are currently only 30 percent of the design capacity and only 50 percent of the anticipated start-up year 2000 peak daily flows. If only average annual wet weather flows are considered, the start-up average daily wet weather flows to the plant were designed at 54,000 gallons per day (gpd). For the year 2005, the average wet weather flow to date is 47,000 gpd.

The pipes, pump stations, and lagoons in the collection system and treatment plant have capacity for significant growth over existing conditions (more than double the existing population). This could change somewhat over time as the wastewater collection begins to develop I&I problems (leakage). The system has operated for 5 years without any increase in I&I which is a very positive sign that I&I should not be a concern in a 20-year planning period.

Hydraulic Capacity Conclusion – Strictly from a hydraulic standpoint (flow of sewage through the collection system, to and through the treatment plant), flows are currently below the flow anticipated for start-up in the year 2000. Hydraulically the plant will be capable of processing water for a population of between 2,000 and 2,900 people using the current per capita discharge rate. This will be tempered later in this report by review of the capacity of the holding lagoon with respect to irrigation. The hydraulic capacity is there for operation during normal weather conditions but concern is expressed about irrigation or holding pond capacity during years with unusual weather conditions.

- **Projected Flow** (build-out of approved lots) –

- **Current 2005 flow per capita** – the average daily wastewater flow is currently 47,000 gallons per day. The current population of Aurora is 870 people. The percapita flow is therefore **54.0 gpd** (gallons per day). This figure tracks well with national figures for domestic flow without I&I (ground and storm water getting into pipes).

- **Projected 2008 flow** - This study projects the 2008 population to be 1,214 people. This is an increase of 344 people beyond the current populaton. If a conservative value of 60 gpd is assigned for the new users, the increased flow will be 20,640 gpd yielding a total flow of **67,640 gpd**.

- **Projected Remaining Capacity in 2008** – The design wet weather flow of the plant is shown as 87,000 gpd in the design criteria on the approved construction drawings. The DEQ used 79,000 in calculating the allowable pollution loading to the Pudding River (in the NPDES discharge permit). The 67,640 gpd figure above remains below either of these design flows (11,360 gpd below the DEQ figure of 79,000 gpd; and 19,360 gpd below the engineer's design flow of 87,000 gpd). It is the opinion of EAS that the design engineer's plant design capacity of 87,000 gpd should be used to establish the plant capacity. At 60 gpcd, this would permit continued growth beyond approved lot build-out of 322 people. At 2.8 people per housing unit, this would permit the addition of 115 additional lots beyond the existing approved lots. These lots could be developed by partitionings and subdivisions of existing infill property within the city limits or by annexation of developable land within the UGB (urban growth boundary). If annexation is considered, it is critical to make an allowance for reasonable infill units from within the existing city limits. It is also critical to allow a buffer at the plant limit is approached. Once the capacity of the plant is determined, a 15 percent growth buffer is recommended. If development is allowed to proceed unchecked up to the limits of the plant, it is likely unusual conditions will cause the plant to have excursions outside the permit limits. This will bring the consequences of actions by DEQ to levy fines and require the City to expend funds to enlarge the plant on a very tight schedule.

- **Wastewater Plant Capacity for Growth** – The flow analysis shows the treatment plant and collection system will not be at capacity when the currently approved lots have been fully developed with homes. An additional 115 lots will remain to be developed after existing lot build-out before the plant reaches the design flow established by the design engineer. Assumptions were made by the design engineer regarding flow peaking from I&I (pipe leakage) that are not happening. On this basis, the original flow limit applied to the plant by its designer may not accurately define the capacity limit of the plant which could well be grater than his projection. Hydraulic flow through the plant however, is not the key limiting factor in the plants design. The ability of the treatment plant to remove pollutants from the wastewater, and store until it can be discharged within the approved permit requirements, must also be considered. This will be reviewed below.

- **Organic and Inorganic Influent Loading (BOD & TSS)**

  BOD and TSS are measurements of the organic and inorganic solids in the sewage which must be removed before effluent from the plant can be discharged to the waters of the state (Pudding River). Removing these pollutants is the primary purpose of the plant. The amount of BOD and TSS passing into the plant from the influent sewage is one of the most critical issues relating to a treatment plant's capacity.

  - **Design BOD and TSS Loadings to the Plant** - The plant is designed to treat and remove 181 pounds of BOD & TSS at its current design capacity (monthly average of daily discharges computed at 0.087 x 250 x 8.34 = 181). The size of the aeration lagoon, aerators, baffling in the aeration lagoon and facultative lagoon treatment in the large storage lagoon are all sized to this level of influent BOD and TSS.

  - **Current Actual BOD and TSS Loadings to the Plant** - The actual loadings in 2004 were 71.0 pounds of BOD and 102.2 pounds of TSS in the sewage entering the plant. In 2005 to date the average is 74.7 pounds BOD and 96.7 pounds of TSS. The two year average is 73 lb BOD and 100 lb TSS. Actual BOD at 73 lb is 0.08 lb/capita/day at the current population of 870. This plant was engineered to treat 181.4 pounds of influent BOD and TSS per day. This is considerably below the 0.20 lb/capita/day normally used for estimating loading for wastewater treatment plants. At an estimated design population of 1052 (this figure not provided by the design engineer), the designed influent strength was approximately 0.17 pounds per capita per day. Actual TSS is 0.115 lb/c/d. With the actual loadings significantly below the design values, the plant will be capable of treating effluent from a greater population than was assumed in the original design.

  - **Projected Remaining Plant Loading Capacity –**

    - **BOD** – 181# - 73# = 108# remaining influent BOD plant capacity (potential of 2,175 total people at current loading percapita). Growth potential = 1,305 people (961 beyond 2008 build-out).

    - **TSS** – 181# – 100# = 81# remaining influent BOD plant capacity (potential of 1,582 total people at current loading percapita). Growth potential = 712 people (368 beyond 2008 build-out).

    - **Conclusion** - Based on these figures, TSS has the highest impact on treatment at this point in time however, BOD may prove most critical over time. This is primarily because excessive TSS can be filtered out of the effluent before it is discharged to the river. BOD can not be filtered and must be treated biologically in the plant before discharge. The influent data analysis above is only one more criteria to be examined. Others will follow.

- **Organic and Inorganic Effluent Loading (BOD & TSS)** – This section again reviews BOD and TSS, but this time by examining the plant effluent being discharged to the Pudding River. The primary purpose of the plant is keep BOD and TSS discharged to the river within limits set in the NPDES permit. These are reviewed below:

- **Design & Regulated BOD and TSS Loadings to the River** - The plant is required to keep discharges to the river within the following upper limits:
  - Concentration - BOD 30 mg/L, TSS 50 mg/L – monthly average
  - Concentration - BOD 45 mg/L, TSS 80 mg/L – weekly average
  - Load – BOD 30 lb/d, TSS 47 mg/L lb/d – monthly average
  - Load – BOD 60 lb/d, TSS 90 mg/L – weekly average
  - Load – BOD 140 lb/d, TSS 220 mg/L – daily max.
  - The above load standards are established for Aurora by DEQ based on the plant discharging 79,000 gallons of effluent per day at the maximum allowed concentrations above. The plant has been able to easily stay within these upper limits.
- **Current Method of Discharge to the River** – Reviewing actual data for river discharge is difficult as the plant does not discharge to the river on a regular basis during the six months each year where discharge is allowed. Over 2004 and 2005 through September, there are 10 months where river discharge is allowed. Effluent is typically discharged for a one to two week period approximately 4 times per year. The remainder of each year, effluent is held in the large storage lagoon.
- **BOD Concentration in Effluent** - Effluent samples are removed from the wastewater automatically by a machine that stores the samples in a refrigerated bottle (automatic 24 hour composite sampler). The bottle is then taken to a DEQ certified laboratory where the wastewater in the bottle is tested for BOD, TSS and other items required by DEQ. These automatic samplers are quite reliable and tests taken in this manner are normally quite accurate. Of the 17 effluent tests taken in 2004 and 2005, 10 of them show N/D (not detectable) BOD and the average of the remaining 7 tests showed a BOD concentration in the liquid of 13 mg/L. Only 4 of the 17 tests were taken while the plant was actually discharging to the river (other tests were of stagnant water sitting in the pipe. Of all tests taken during discharge to the river during 2004 and 2005, all show N/D readings for BOD. It is unusual that a treatment plant will have no BOD in its effluent. It is unlikely that this condition will continue into the future as the plant loading increases.

  Conclusion – Tests show the treatment plant is removing all of the BOD from the influent sewage. This is truly remarkable but it clearly shows the plant is currently functioning well below the anticipated discharge BOD concentration (mg/L) and load (pounds). On this basis, the plant has remaining life of the entire design population estimated at 1052 however this assumption is not made in this report.

Table 6 provides a review of the requirement of the NPDES permit and how the city is currently doing.

- **TSS Concentration in the Effluent** – Of the 17 tests taken over the past two years, the average discharge TSS was 9 mg/L. One test shows N/D, the others vary from 2 to 20 mg/L. These results are also excellent for a lagoon plant. The plant is permitted to discharge at a concentration of 50 mg/L as a monthly average. This compared to the existing 9 mg/L shows the plant is operating considerably below the design loading anticipated at the start-up of the plant.

- **BOD Loading to River** – When the concentration is N/D, there is no measurable BOD loading to the river. If the BOD concentration was at the loading rate of the average measurable values (tests taken when plant not discharging to the river), the load to the river would be 13 x 0.450 mgd (ave.) x 8.34 = 49 pounds. The permit allows 140 pounds in one day and an average of 60 pounds per week and 30 pounds for discharge over a full 30 day month. Currently the plant discharges for only about 30 percent of the allowed days each month. If the discharge was pumped a few hours each day to meter the discharge over the full month, the discharge would be 16 pounds per day, or approximately half of the allowed discharge. This assumption would indicate the plant can meet the needs of at least 1,740 people before reaching capacity however this assumption is hypothetical as the plant is currently not discharging any BOD at all.

  Conclusion - Under any method of BOD review, the plant has a treatment capability at or well beyond a population of 1,740 people.

- **TSS Loading to River** – The average TSS from the plant to the river is 9 mg/L. This is an extremely low value for a lagoon plant. Loading to the river varies from 7 lb/day to a high of 75 lb/day. The permit allows 220 pounds per day, 90 pounds per week and 47 pounds for a monthly average (assumes 30 days of daily discharge). This limit can be easily met with current plant loading. The current loading rate is 0.45 mgd x 11 days/mo x 10 mg/L x 8.34 / 30 = 13.8 pounds/day for an average month. 47 pounds is allowed. The plant is therefore operating at less than 30 percent of its TSS discharge capability. As the plant reaches its design loading the TSS in the lagoon will increase sharply.

  Conclusion - Adding TSS load to the plant will not impact the discharge TSS in a lineal manner, therefore it would appear that the plant is truly operating at just under 50 percent of its design capacity. This said, it is estimated the plant will be able to treat wastewater from approximately 1,800 people before TSS discharges will exceed permit limits.

- **Wastewater Plant's Current Level of BOD and TSS loading** – Experience would indicate that the plant effluent concentration and loading is currently not completely reliable for projecting the remaining growth the plant can accept before it reaches its capacity. This is in part because of the extremely low values of BOD and TSS for an aerated lagoon plant. Having no detectable BOD during all river discharge over the past two years is almost without precedent. It is therefore reasonable to compare the design plant influent loading rate vs the actual influent loading rate. On this basis, the analysis above shows the plant is operating at 55 percent of its design capacity. On that basis the plant can support growth to the projected 2008 population of 1,214 plus an additional equivalent population of 368 from a pollutant loading standpoint. This may proved to be a somewhat conservative prediction (plant may be able to successfully treat wastewater from a higher population) but the above figure seems reasonable to EAS.

- **Review of other plant components for capacity concerns**
  - **Aerated lagoon** – The existing plant consists of two plastic fabric lined earthen ponds – a small treatment lagoon and a larger holding lagoon. The small treatment lagoon is an elongated pond with hanging fabric baffles to divide it into treatment cells. The first four cells are utilized for mechanical aeration to provide an oxygen rich environment allowing bacteria to remove the nutrients from the sewage. The organic material is converted to a sludge which settles on the bottom of the two settling cells before the semi-clear treated water drains by gravity into the large holding lagoon.

    The design of this component is based on the influent sewage BOD and TSS loading. Without a headworks, the existing floating AirO2 aerators foul with debris (rags and stringy material from the influent sewage) which seriously diminishes the effectiveness of the aeration cells in this basin. With a new headworks installed (currently planned and budgeted), all the aerators can be kept on-line and the lagoon will be able to operate at capacity. The plant is currently doing an excellent job of treating the waste load entering the plant with severely diminished aeration capacity. Improved aeration will maintain this treatment level to and beyond the build-out of approved lots. A new headworks is scheduled to be installed within the next few months. Following its installation, sludge will be removed from the aeration basin, thus removing the material that fouls the aerators. This will in effect double the aeration potential of the plant.

    The aerated cells combined with settling cells, followed by a large facilitative lagoon, is a very efficient approach to small city wastewater treatment. As the city grows, this approach however, must eventually be replaced with another approach to treatment, unless a site can be found to permit a significant expansion of the plant. Upgrades and refinements, this plant can be made to extend its life to serve the population of the city to an equivalent population of between 1,800 and 2,200 people. Any possibility of extending its life beyond this population level will require a detailed facilities plan prepared by a sanitary engineer. If land can be found to expand the plant and irrigation, this method of treatment could meet the needs of the city to a population of 20,000 to 30,000 or more.

It is recommended that sludge be removed from the settling portion of the aerated lagoon on a 3 to 5 year cycle to keep the process at maximum efficiency.

- **Storage lagoon and Irrigation** – The primary purpose of the storage lagoon is to provide flexibility to the operator. It allows hold the effluent on site between periods of effluent discharge to the river or to irrigation. It also permits storage of effluent during periods of time when discharge would violate the discharge permit. Currently, the capacity of this lagoon requires very careful water discharge management. This lagoon's required capacity is based on flows to the plant and the ability of the operator to discharge that flow to the river or irrigation in an efficient manner. There is approximately 7.5 million gallons of storage volume in this lagoon (plus 1 MG of sludge storage). The current influent flow of 47,000 gallons per day, accumulates water in the lagoon at the rate of 1.41 MG per month. At the design flow of 87,000 gallons per day, water will accumulate at 2.61 MG per month. If the lagoon is drawn down at the end of each discharge cycle to its lowest level, the plant can operate without discharge for 5.3 months currently and for 2.9 months at design flows. This was determined to be adequate in the plant design. The design flow of 87,000 will be a population equivalent of 1,610 at current flow per capita.

  The sludge level in the large holding lagoon should also be monitored. The plant design provides for up to 0.98 million gallons of sludge storage in the main lagoon. The withdrawal piping will not permit the operator to remove water from this sludge storage area. This level of sludge storage should not be exceeded or it will begin removing effluent storage volume. Cleaning of this large lagoon will likely not be required more often than once every 15 to 20 years, although the operators have some concern about the duckweed growth on the water surface. Duckweed may not be a significant problem as it reduces light penetration into the water, thereby reducing the development of algae in the lagoon. Algae growth will increase the TSS in the effluent.

- **Operating Experience with Capacity of Storage Lagoon** – The treatment plant operator, Ricky Sellers, indicates that the capacity of the storage lagoon is currently causing operational problems. The problem occurs when discharge to the river or to irrigation is prevented by DEQ or unusual weather. Examples:

  - **Normal** - In a normal year, the lagoon is lowered to its lowest level by October 31 and April 30 of each year. If this can happen, there will be no problem staying within permit, and the storage volume is much more than adequate, even at the design flow of 87,000 gpd.

  - **Late Fall Rains** – Discharge of effluent is normally permitted to the river starting November 1st of each year. If normal fall rains do not arrive by mid October, the Pudding River flows will not rise to an acceptable level by November 1 and DEQ can delay the discharge date until the river flows are adequate. This delay can vary from a few days up to 2 months. If Ricky is able to pull the lagoon level down over the summer to minimum levels by fall, the lagoon will have adequate storage even at full design flow to not discharge for these two months and could go even up to three months.

- **Late Fall Rains combined with low fall irrigation** – Under conditions where the fall is wet enough that irrigation is difficult, the river flows will normally be adequate by November 1, to discharge and the storage lagoon will be of adequate size, even at design flows of 87,000 gpd. This particular year (2005) both light fall rain and the inability to irrigate are combined with a wet spring to cause the operator some concern. A wet spring greatly restricted irrigation for the first three months of the irrigation season (May, June and July). In trying to catch up for the low spring irrigation, the irritation site has become saturated limiting irrigation and preventing the operator from pulling down the holding pond to needed low fall levels. To the date of this draft report writing, rainfall has been inadequate since October 1 to raise the flows in the Pudding River a significant amount. Rain is forecast for late October and early November so the flows may increase adequately. At final report, the rains did come at the last minute and DEQ did not restrict discharge to the Pudding River so the operator had no problem staying within permit. This situation however, does flag the concern that if we had a two month dry period in November and December where the DEQ restricts river discharge, the operator would be forced into a position of discharging effluent outside the limits of the permit, resulting in notices of violation or fines from DEQ.

    - **Maintenance approach to reduce this problem** – The 2005 irrigation season was significantly impacted by the wet spring. The operator irrigated no days in May and only 7 days in the last half of June. He was able to irrigate off and on during July. During these 3 months, influent equaled 4.28 MG but only 1.61 MG was irrigated for 2.7 MG accumulation in the lagoon. To complicate this, it has not been the practice since the plant was constructed to pull the lagoon down to the lowest possible level on April 30th as it was felt some water needed to remain in the lagoon to water the poplar plantation in a dry spring (6 feet vs. 2.5 feet or over 1 MG). In addition there was 9.3 inches of rain directly into the lagoons which added another 0.50 MG. Ignoring evaporation (which was low during this rainy period), the operator was required to dispose of 4.2 MG (2.7 + 1.0 + 0.5) beyond the normal influent of 4.3 MG for a total of 8.5 MG to irrigate in the remaining 3 months of the summer. Attempting to irrigate at double the normal rate caused the soil to saturate, limiting the irrigation that could be applied.

      Although it may not have been possible to irrigate all the wastewater stored in the lagoon over the shortened summer of 2005, it is likely the soil in the poplar plantation has compacted and slime sealed the upper few inches. These conditions reduce the ability of the soil to take in water. Deep tilling this soil would increase its ability to retain water. Because of the significant slope to the plantation, a second option is to construct soil dams throughout the plantation to retain irrigation water and reduce the potential for runoff. A third and possibly the most practical option is to make several passes through the plantation with a plug aerator that removes soil plugs from the ground leaving a small open hole allowing better water penetration. Any work in the plantation must be done carefully to prevent rainfall runoff from discharging soil from the site during the winter or other high rain periods. It is critical to the success of the treatment plant that the plantation be able to receive the flow it is designed to receive with some buffer for unusual weather conditions. Currently it would appear the plantation and holding lagoon have limited ability to deal with weather years as unusual as 2005. This concern will grow over time. To increase this buffer, the holding lagoon could be enlarged or the acreage of irrigation increased. Site restrictions would make expansion of the lagoon very difficult.

  - **Long Term Approach to Irrigation** – Aurora does not have a permit to discharge treated effluent to the river during the six months of the summer. It is therefore necessary for the city to maintain a viable irrigation program for the summer months. Due to the current relatively low porosity of the soils and relatively steep slope of the poplar plantation, some action is needed. The interim maintenance work above (using a plug aerator throughout the plantation) should resolve the immediate problem and likely will be adequate to meet the needs of the approved build-out lots. Expansion of the plantation however, may prove to become necessary to meet the needs of growth above the build-out level. The city should begin immediately developing a plan to expand the irrigation site to be assured adequate irrigation is available for growth, and to provide maximum flexibility to address unusual weather conditions. In addition, it has become apparent that irrigation is the single greatest wastewater treatment problem that is not already being addressed. A management plan is needed for operating the irritation system in a manner that can assimilate unusual weather conditions and where the system can discharge the absolute maximum water to irrigation during the 6 summer months.

- **Wet Spring** – The year 2005 was unusual as rainfall continued in May, June and even July (first three month of the irrigation season) at rates equal to or higher than the first four months of the year, which normally is a very high rainfall period of the year. High rainfall in March and April saturated the soil then continued rainfall in May, June and parts of July made irrigation of effluent very difficult. A wet spring can delay irrigation of effluent many weeks into the irrigation season. In 2005, it impacted half of the total available irrigation season, three months. If the lagoon has been completely emptied on April 30th, 6 months of plant flow plus rain into the lagoons must be irrigated in the remaining 3 months to keep the lagoon level low for the possible chance that the fall rains would not have river flows high enough to permit discharge in early November. Although the plant was not designed for this unusual condition, it happened this year. To protect against this condition in the future, the expanded plantation area should be considered to provide flexibility for unusual weather.

- **Difficulty in Managing Irrigation Water in the Lagoon - Summary** –
  - **Available Storage** - This lagoon has up to 7.5 million gallons of useable storage.
  - **Spring Drawdown** - The current and former operators have been reluctant to pump the lagoon to its lowest level on April 30th because the poplar plantation may badly need water if the spring is unusually dry. A lack of irrigation water could possibly result in some tree loss and a loss in wood production.
  - **Operation Recommendation** - Due to the experience of 2005, it is recommended that the lagoons be pumped to their lowest level on April 30th to provide the maximum storage volume in the lagoon. If unusually high rainfall in the spring restricts spring irrigation of effluent, this will provide the maximum effluent storage for the irrigation season. Priority must be given to operating the plant within the NPDES permit.
  - **Water Balance** –
    - **Influent** – 1.45 MG per month over the summer (current); the design influent rate is 2.61 MG/mo.
    - **Evaporation** – 0.25 to 0.40 MG per month over the summer.
    - **Irrigation** – 6.7 acres of poplars. The current irrigation rate at balance calculates to be 1.10 MG per month. This number will increase to 2.26 MG per month at design flow. Discharge at this rate will be 0.41 inches of irrigation per day, which is the design plantation loading. In August 2005, the operator was irrigating at 0.47 inches per day which caused saturation in the plantation. In the future, every effort should be made to keep irrigation at or below 0.40 inches per day. This again shows that the poplar plantation (tied to the size of the storage lagoon) appears to be the most growth limited part of the wastewater plant, but only because of unusual weather conditions.
  - **Plantation** - Poplar trees are very flexible, once established, in that they will use high quantities of water when it is available but can also survive well during low water periods. Because

they are deciduous trees, their need for water trails off from mid September through October. Added acreage with a crop of vegetation that can better utilize water in the fall would assist the operator extending the irritation season for the full available 6 month period. The primary requirement for the operator is to operate the plant within the requirements of the NPDES discharge permit. This must override all other considerations.

As noted above, currently the volume of the storage lagoon (tied to the poplar plantation) is the greatest capacity problem at the plant. In a normal year, the operator easily has the ability to discharge effluent every month of the year. In this average condition, the lagoon capacity is not a problem, even at flows greater than the design loading. Storage only becomes a problem when weather or DEQ prevent the operator from discharging for an extended period of the limited half year irrigation season. 2005 nearly was one of those years. Finding a way for the plant to better assimilate unusual weather conditions is the first priority for plant expansion.

Irrigation management recommendations:

- Develop an **irrigation management plan** that provides the operator the maximum ability to keep discharges within permit limits. Establishing lagoon levels at different times of the year and development of a table for daily maximum irrigation levels to prevent soil saturation at various weather conditions are items to be included in this plan.
- **Aerate the soil** of the plantation with multiple passes of a plug aerator to permit better water penetration into the soil and improve soil aeration.
- **Add irrigation acreage** to provide an increased margin of safety to the operator to keep the plant within permit. It is further recommended that this be done before additional land is added to the city limits for development. Adequate flexibility already exists during the river discharge period if the operator can lower the storage lagoon to near its lowest level by the end of the irrigation season. Approximately 2/3's of the lagoons 7.5 MG storage capacity will allow no river discharge for two months at full design flow. Historically, this would be adequate.
- **Crop** – Cropping of the new irrigation acreage should be carefully considered. A crop that requires more water than poplar trees should be considered if such a crop exists.

- **Irrigation** – Irrigation needs are covered in detail in the storage lagoon section above. This section provides a brief summary of effluent irrigation in Aurora.

  DEQ requires that effluent irrigated to the plantation remain on site with no runoff to neighboring property. In addition, there must be sufficient plant uptake and evaporation to prevent the irrigated water from flowing down into the groundwater table. As explained above, this year, Ricky had a problem irrigating all of the available water because weather conditions reduced the irrigation season and the soil has become saturated limiting the amount he can apply without runoff. The saturation is because he must attempt to irrigate approximately 8 months of plant effluent primarily during a 3 month period at the end of the summer irrigation season.

To complicate the problem of getting maximum irrigation on the plantation site, it is likely that the soil has become compacted and sealed from 5 years of irrigation. Options are considered above and making several passes with a plug aerator is recommended. The plantation site is on a sloping hillside. This greatly increases the potential for runoff before the water can be taken into the soil.

Except the summer of 2005, the existing irrigation loadings are well below the design capacity of the plantation. Population growth to the design flow of 87,000 gpd should also match the plantations capacities if a means can be found to reduce the saturation/runoff problem and if weather conditions permit irrigation of all influent over the summer. At the current percapita loading, the design flow would equate to an equivalent population of 1,610 people. All aspects of the plant appear to be able to support this population with the possible exception of the irrigation area. Being able to discharge summer flows by irrigation is the single most critical concern at the treatment plant. This is only a concern during unusual weather conditions however current weather patterns have been unusual for several years. It is recommended above that the city take steps to expand the irrigation acreage before land is added to the city limits for development.

- **Drum Filter, Flow Meters, etc** – Plant influent flows govern the capacity of these units. A review of the predesign report and design criteria shows these components have rated flows greatly in excess of the existing and projected flows. Flows can more than double from the existing levels before these items need be studied.

- **Pump Stations** – The plants pump stations will also match the projections above and appear to have capacity considerably beyond the existing and projected flows. These stations have capacity approximately four to five times the existing flows. The collection system pump stations may need pump upgrades before the plant but none are close to their rated capacity, again by a factor to 3 to 5 times the current flows. The force mains are sized from these stations such that when the existing capacity limits of the stations are stressed, the pumps can be upsized easily at relatively low cost to add needed capacity. At some point in the future when the city population exceeds 1,800 to 2,200, one of more of the stations and force mains will require study and possible replacement.

- **Future Plant Expansion**

  - **Adding Capacity** – When the plant reaches capacity, it will be difficult to expand. Its site is extremely limited and modifying the existing plant will be difficult while it remains in service. In addition, as noted earlier, the permitted levels of river and poplar plantation loadings will not increase as the plant is enlarged. This means that the quality of treatment must continually get better and the poplar plantation must be enlarged with each plant expansion.

- **Existing Plant –**

  The purpose of the holding lagoon is to provide some level of polishing treatment but primarily to store the plant effluent so it can be irrigated on poplar trees during the summer and discharged to the Pudding River during the high river flows of the winter. It eliminates the need to continuously discharge effluent. Effluent can be stored for periods of time permitting discharge for relatively short periods per week or month. The storage is also needed needed because there are periods of the year when no discharge of the effluent is permitted under the DEQ rules. It must be stored until discharge is permitted. On occasion, unusual weather conditions can cause the operator to wish he has added storage capacity. Some new approaches to plan operation may help this problem. As noted earlier, managing this storage capacity has been the most difficult operational problem at the plant.

  The existing plant and the poplar plantation utilize all of the available land on the City owned site. The two lagoons are perched on the top of a steep hillside above Mill Creek making expansion nearly impossible. On the opposite side they are against railroad right-of-way. The treatment plant building is positioned to block potential expansion of the holding lagoon to the south. A second holding lagoon could be constructed south of the plant building but it would displace poplar trees which must be replaced at a new adjacent site. Raising the height of the lagoons may be possible but only at considerable cost. The city has no alternative to using this plant during any expansion so modifying the lagoons would be quite difficult.

- **Summary of the Wastewater System Growth Capacity**

  - **Collection System Piping** – There are no known problems with the pipe sizes that will impact the expansion of the city. Most of the system contains 8 inch gravity sewers laid at a grade of 0.4 percent grade. A pipe at this grade will pass a flow of 340 gpm with is approximately 10 times the current flow from the entire city. Considering peaking flows the city could expand to a population in excess of 4,000 equivalent people before gravity pipe size will become a concern. The force mains from the pump stations are sized similarly such that they will handle an expansion of 3 to 5 times the existing population in their basin before pipe size will become a concern.

  - **Collection system Pump Stations** – All the pump stations were designed for flows that assume a modest pipe leakage. They are therefore designed for peak flows that exceed existing peak flows by more than three fold. The main pump station was originally not designed to the criteria contained on the plans and functioned at approximately 20 percent of the design flow initially. The pumps were subsequently replaced in this station and flows now are adequate for existing flows plus the approved 2008 population and beyond. At some point, the capacity of this station will again be stressed by flow from the entire city. Another pump size increase will easily resolve this at relatively low cost ($15,000 to $30,000 compared to a station replacement at $200,000+).

- **Hydraulic Loading Capacity of the Treatment Plant** – EAS projects, in this report, that the treatment plant has adequate hydraulic capacity to handle the flows of the projected 2008 population of 1,214 plus an additional population of between 189 and 322 people before it will begin reaching the limits of any of the system components. The capacity could be expanded beyond that with modest modifications. Most of the plant hydraulic facilities will easily handle 3 to 5 times the current flow. It is recommended that additional land be acquired and developed to expand the irrigation capacity of the plant to provide a contingency for unusual weather conditions that could cause the plant to discharge effluent outside the limits of the DEQ permit.
- **Pollutant Removal Capacity of the Plant** – Detail of removal capacity is provided earlier but currently the plant is doing an extremely good job of treating the wastewater. Analysis indicates that it will continue to easily remain within the limits of the discharge permit at the build-out 2008 population plus the 189 and 322 people projected above.

- **Options for Expansion –**
  - **Summer Discharge** - The DEQ issued discharge permit prohibits discharge to the Pudding River during the summer. Mill Creek is too small to be considered for discharge. It is therefore necessary for the city to irrigate summer effluent or store it in a huge lagoon for winter discharge. Constructing a lagoon large enough to store all sewage over the summer would be impractical near the site due to significant topography. Summer irrigation continues to be an excellent option for the city.
  - **Continue with same treatment concept** - A parallel plant could be constructed on the poplar plantation but added nearby land must be purchased and developed as poplar plantation first, before the existing poplars can removed for plant construction. The added land must be near the existing plant site due to conveyance limitations (pumping and piping the effluent from the plant site). An analysis by a sanitary engineer is needed to determine if permit limitations can be met if the same treatment process is used in the plant expansion. It is likely that effluent filtration or another treatment process may be needed for the expansion. Planning and phased construction will require this process to begin a minimum of 5 years before the actual expanded plant will be placed in service.
  - **Add a second plant while continuing to operate the existing plant** – This is possible to consider. The second plant can be any type of plant available within current DEQ approved technology. The limitations against summer river discharge and the need for storage during periods of non-discharge will likely require the addition of a second holding lagoon. Plant types to be considered would include:
    - **Conventional activated sludge** – High construction and maintenance cost
    - **Sequencing Batch Reactor** – High construction and maintenance cost
    - **Oxidation Ditch** – Medium construction and maintenance cost but takes more land area.

- **Facilitative Lagoon** – Requires large acreage of flat land but very low maintenance cost. A typical lagoon plant would have difficulty meeting river discharge limitations without effluent filtration.
- **Rotating Biological Contactor** — High construction and maintenance cost. In recent years, RBC's have not been popular for new plants.
- **Membrane Filtration** – Very high construction cost and medium maintenance cost. This is state of the art treatment and produces excellent effluent. Ideal where load limits to the river are fixed. Costs are expected to come down significantly over time, as this process becomes more widely used.
- **Aerated Lagoon** – Same system we have now – Low initial cost and medium maintenance cost. An expanded plant may have difficulty meeting river discharge limits without final polishing treatment of effluent, such as filtration, however this is a very practical approach.

- **Cost** – For a planned population growth of 20 years, any normal conventional plant could cost in the range of $3 to $6 million dollars. I designed and constructed a SBR plant for Stayton in 1995 designed to serve 11,000 people and cost $10 million. That cost would be more like $16 to $18 million if constructed today. If the population projection for Aurora is say, 3,500 people, I would think any conventional plant designed to be expanded will cost in the range $4 to $6 million if it replaces the existing plant and less if operated as a parallel plant with the existing one. To get to the lower end cost range of $2.5 to $4 million, an innovative design will be needed, much like was done for the existing plant.
  - **Action Needed** - Under any growth scenario, the existing plant will be approaching the end of its design life with build-out of the existing approved lots. It is important that the city begin planning for an expansion of the plant now if annexations are to be considered to bring the area, currently within the UGB, into the city (which is the purpose of having a UGB). EAS recommends that within one year to 18 months, a study be undertaken by a sanitary engineer to consider when and how the plant should be expanded to add capacity for additional growth, 20 years beyond the build-out of approved developments. This study will likely cost between $40,000 and $70,000. At the same time, an economist should be hired to develop a funding package which would involve an SDC and water/sewer rate study. This will likely cost between $15,000 and $30,000.

- **Treatment Plant Conclusions**
  - **Flow/Loading Projections** - Wastewater flows and loadings are currently below the start-up levels projected for the plant. The plant appears to have the capacity of handle the population added by the all approved lots with remaining capacity for between 200 and 320 additional people. EAS latest projections show the plant will be at its ultimate capacity at a population of approximately 1,800 and 2,200 people. The one element of the plant that limits this projection is the irrigation plantation. Although the numbers show the plantation is adequate for this population, practical experience has shown that an expansion of the plantation is needed to protect the city from

the effects of unusual weather patterns that limit the ability to irrigate during wet summer months. Expanding irrigation land is recommended as quickly as funds can be made available.

- **Future Plant Expansion** – As noted above, the existing plant will be difficult to expand. The site is extremely limited and modifying the existing plant will be difficult while the plant remains in service. EAS recommends a study be undertaken by a sanitary engineer to consider when and how the plant should be expanded to add capacity for additional growth beyond the figures above.
- **Complete Planned Projects** – All the above comments assume the city will proceed with installation of a new headworks screen and repair of all aerators. They also assume the existing sludge will be removed from the aeration lagoon. This will provide more sludge capacity and will remove all stringy material from the lagoon that has been fouling the aerators.

Wastewater Collection System Summary

- **Flows** – Aurora has a brand new collection system constructed of PVC pipe throughout. This pipe has been tested for joint leakage and is found to be nearly bottle tight. This makes the system unique in the state of Oregon as it has almost no groundwater infiltration. Because it is new, it also has no inflow sources from area drains or downspouts. The passage of time for the next 20 to 40 years should see little deterioration or added leakage of the system although some manhole leaking would be expected in time. These factors mean that normal flow projection numbers do not apply in Aurora however, increasing system I&I (groundwater leakage into the system) must be assumed in long range projections.
- **Gravity Sewer Pipe** - The existing 8 inch sewer system can handle much more population than would be the case in a normal Willamette Valley system. An 8 inch sewer pipe laid at a minimum grade of 0.4 percent grade can handle a flow of 500,000 gallons per day. This is more than 5 times the estimated existing peak flow to the main pump station. Using this figure, the population of Aurora could expand to a population of between 3,500 and 4,000 people before the main trunk sewer system will require larger pipes. Again, this would not be the case in other cities.
- **Pump Stations and Force Mains** – The three smaller pump stations discharge to 4 inch force mains. These mains have the capability of discharging between 200 and 300 gpm at reasonable velocities. The main pump station has a 6 inch force main which is capable of 500 gpm at reasonable velocities. 500 gpm is over 600,000 gallons per day which again is more than 5 times the highest peak flows now being handled by the pipe. This means that at such time as any of the four pump stations reach capacity, it will be possible to upgrade the stations with larger pumps to increase capacity, without replacing the force main. This can be done at a reasonably low cost which would not be a major growth concern. 20 year SDC fees should anticipate these upgrades if growth will be allowed to continue unchecked.
- **Expansion within UGB** – As the city continues to grow within the UGB, it may be necessary for this development to add one or more additional pump stations. Adding pump stations should be done with great care and study. For instance, the

natural slope of the land drops as development progresses to the south from the existing developed city. It also consists of two or three basins draining to the east to undeveloped EFU land. The existing sewer system has limited ability to serve this property. Adding multiple pump stations as development progresses to the south would not be in the best long term interest of the City as pump stations are quite costly to maintain, even if they are initially constructed by a developer. One additional station should be designed to cover all of the area within the UGB and beyond if further expansion to the south is likely. Due to the existing topography, it may be costly for development to extend gravity sewer, pump station and force main outside the existing city limits.

- **Collection System Conclusions**

  - **Gravity Pipe Size** – The gravity portions of the collection system will not require upsizing until the population reaches 3,500 to 4,000 people at which time peak flows may require some sections of the collection system to be upsized.

  - **Pump Stations and Force Mains** – In general, the existing force mains are sized for growth in population to 3,500 to 4,000 people before the whole system will become seriously strained. Concentrated growth in one area may cause a limited part of the system to reach its capacity before that population is reached but in general, the gravity and force main piping system will handle significant growth. Individual pump stations may require pump upgrades as they reach their existing capacities. These upgrades would typically be in the cost range of $25,000 to $50,000 (today's cost). This is considerably less that the cost of a full pump station replacement which today typically costs between $200,000 and $300,000 ($250,000 for a basic station but many exceed $300,000).

  - **Collection System Summary** – The collection system can adsorb a population increase of between 3,500 and 4,000 people before major upgrade is needed. One or more individual pump stations may require upgrades depending where and how this population grows.

  - **Timing** – Although the presentation above shows that it is likely that the wastewater system will support a population in excess of 1,800 people, the treatment facilities will become highly stressed when population reaches this level. Keeping the plant within the DEQ permit will become difficult as the equivalent population exceeds 1,600. Regular DEQ permit violations require the city to take action to bring the system back into compliance. In addition to costly fines, this typically requires construction of added plant capacity or specific new treatment elements such as effluent filters. It is absolutely critical that the city move ahead during the build out period of the existing approved lots to study the treatment plant expansion solution and set up a funding mechanism to begin the new plant before the current plant actually reaches its upper limit. The funding, planning and construction of a treatment plant is typically a 5 to 10 year process, 5 years being the minimum.

Wastewater Recommendations

1. **Expand the Irrigation Plantation** – Adequate land for irritation appears to be the most time dependant issue for the wastewater system. This is only needed when unusual weather patterns restrict the time and amount of irrigation during the summer. If irrigation restrictions are combined with low fall rainfall starting mid-October such that river discharge is delayed, the holding lagoon may not have the needed storage volume. Solving this requires either expanding the size of the holding lagoon or adding more irrigation area. Due to the high construction cost and lack of space available on or adjacent to the plant site, for a holding lagoon expansion, it is recommended that irrigation land be added to the plant as quickly as possible it assure the plant will remain within its discharge permit limitations. Increased irrigation land will be required for a plant expansion under all apparent options. Any new growth should participate in this project.
   - **Procedure** –
     - EAS to secure the services of a sanitary engineering firm to size the needed irrigation acreage and locate site options to secure the land. If desired, the city would utilize a request for proposals and secure the engineer directly. An estimate of cost for this work will be prepared and submitted for approval before proceeding. EAS does not yet have a firm to recommend for this work.
     - A report will be submitted to the City Council outlining size, sites and costs with recommendation.
     - Funding of the project would be developed by a financial consultant. A financial plan will be developed, reviewed, adopted and implemented to acquire the land. I recommend Ray Bartlett.
     - A land acquisition firm will acquire the site. Right-of-way Associates handled this for the present plan and I would recommend them for this project also.
     - Grade and plant the site. Install irrigators and piping to site plus modification to operating software in plant office. Work can be by contract, self-help, developer, or combination.
2. **Plant Expansion Planning** - As the approved subdivisions and partitionings reach lot build-out (approximately 2008), over 70 percent of the wastewater treatment plants capacity will be used. Permitting development to stress the plant above 85 percent capacity is not recommended without an expansion and funding plan in place. The city should begin a planning process to examine how the treatment plant can be expanded and how this planning and construction will be funded. This study can be undertaken by a subconsultant to EAS, by a firm selected directly by proposals to the city or by a developer's engineering team reviewed by a city technical advisory committee. It is recommended that this study be underway within the next 12 to 18 months. Cost of the study is estimated at between $50,000 and $80,000.
3. **Treatment Plant Expansion** - Because no obvious written plan has been located for expanding the treatment plant, the city should use caution in adding additional significant developments to the city until some plan has been developed to accommodate the wastewater from added growth. Approximately 60 to 80 units of housing beyond build-out could be added before the plant loading becomes

stressed. Building up to the maximum capacity of the plant opens the door for very costly permit violations and DEQ ordered corrections. The city generally is much better off if it plans its own destiny rather than being ordered to comply by DEQ. In some cases, a DEQ compliance order will open the door for low cost loans or grants but this is walking on dangerous ground! This recommendation is tempered by recommendation 1 above which should proceed before any development land is added to the city beyond 10 lots.

WATER SYSTEM

General

Existing Master Plan –

- **Existing Master Plan** - A water master plan was produced by JMS Engineering for the City of Aurora in 1996. This plan considered growth of the city at a rate of approximately 2.75 percent per year. Population of Aurora at that time was 650. The study provided a 20-year projection to 1,130 people by the year 2015. Projections in this report show this population may be reached by the year 2007.

- **Master Plan Review** - This master plan was written with the assumption that Aurora would remain a relatively small city with limited resources and little growth anticipated beyond the 480 new people projected. It provided for very modest residential level fire flows city wide and was geared to provide basic domestic water supply for homes and businesses. It basically assumed larger fires will be fought with tanker trucks and did not provide significant fire protection from the distribution system. From the population projections presented at the beginning of this report, the design year population of the water master plan will be reached in the year 2007 and will be exceeded by 184 people (18 percent) by the projected approved lot build-out year of 2008.

  Because this master plan was developed with the assumption that the city would remain very small, the recommendations tend to underestimate the actual needs of the community. All facilities are undersized in a manner that makes them incompatible with growth. Small diameter pipes are proposed that will have limited fire and domestic flow for the city as it grows thereby requiring these facilities to be replaced in the future with larger pipes, reservoirs, etc. Based on current growth trends, it is my opinion that direct implementation of most of this plan would not be in the best interest of the city.

Water System Overview and Needs

- **Water Supply**
  - **Existing Well** - The existing water source is two wells drilled in the central city park plus an abandoned well on the bank of the Pudding River at 4th Street. A new third well has been drilled and will be operational within weeks. During the summer of 2004, the two operating wells were found to be producing approximately 220 gpm of reliable water which is less than half of the supply previously believed to exist in these wells. Production is somewhat higher during the winter months but the supply has dropped significantly from the 500 gpm of several years ago. The limited water supply is complicated by having only 300,000 gallons of storage. Additional storage is needed so the diurnal demand peaks can be met from storage, without loosing the needed fire protection storage, thereby stretching the effectiveness of the limited supply.
  - **New well** – As a condition of annexation of the VanLieu property, G Cam Ltd was to construct a new 300,000 gallon reservoir on a site he was to purchase adjacent to the existing reservoir west of Highway 99, south of Ottaway Road. With the updated existing well water production data made available during the late summer of 2004, priorities were shifted from storage

to supply and the funds to be expended on the reservoir were redirected to a new well. After hydrogeological investigations, a site was selected on the Byres property (Keil Park 2) and bids were received by Mr. Cam to construct the well by early summer, 2005. This well was anticipated to produce between 200 and 300 gpm. Testing of the well shows an addition of between 150 and 200 gpm depending on time of year and how hard the well is being pumped. It is estimated that approximately 175 gpm of reliable summer water production (150 gpm if pumped continuously, 24 hours per day) will be available from this well for the foreseeable future.

- **Total Water Supply** – With the new well on line within the next few weeks, the city will have a summer water supply of 146,000 gpd from the two original wells plus 216,000 from the new well for a total daily supply of 360,000 gpd during the warmer summer months. With the limited existing reservoir capacity, the new well can not be pumped on a 24 hour basis which limits its daily production to between 147,000 to 168,000 gpd. Using the average of this new well capacity, the total water available to the city will be approximately 300,000 gpd or a little more than double the existing supply. By adding a new reservoir this number could be increased to the 360,000 gpd.

Water Demand

- **Available water – Table 6** lists water production data for the past four weather years, ending with September 2005. The computer spread sheet was able to take the basic data from the operator and express it in much more detail. I developed population figures for the months of available data to let the spreadsheet calculate per capita water use.

  The table shows the existing wells produce about 190,000 gallons per day in the July but either the well production of the demand drops production to about 145,000 gpd in August and 100,000 to 120,000 in September.

  It is interesting to note that water production has been steadily increasing, even with requested water restrictions the past two summers.

  The wells are typically worked about 14 hours per day and rested about 10 hours per day. The 190,000 gpd above will result in the two pumps operating at a combined 226 gpm for 14 hours of operation. Bob Southard indicates this is near the maximum sustainable yield of the wells in the early part of the summer but will tend to drop below this production rate in August and September (about 150,000 gpd).

  It would be possible to pump the wells continuously 24 hours per day but this will require the operator to further restrict the outlet valve to prevent the pumps from drawing the water surface down to the pump, thus damaging it. Unless the reservoir was drawn down to low levels, the nighttime water production would overfill the reservoir due to low nighttime usage.

- **Existing water use** – Table 6 shows trends in water use. Following is a brief summary of several of these observations:
  - **Overall Trend** - Water demand has been increasing even with requested water conservation. Over the 4 year period, the population increased by 190 people or 28 percent. During this same period,

Table 6

CITY OF AURORA

WATER PRODUCTION

12-4-04

Year	Mo.	Days	Well #3	Ave. Draw-down	Well #4	Ave. Draw-down	Total	Ave gpd	Ave gpm 10 hr day	Assu. Popul.	Ave gpcd	Ave. gal/day per Well			Ave. gal/min per Well			Ave. gal/min per Well		
												Ave gpd Well #3	Ave gpd Well #4	Ave gpd Both Wells	24 hr day Well #3	24 hr day Well #4	24 hr day Both Wells	14 hr day Well #3	14 hr day Well #4	14 hr day Both Wells
2001	Oct	31	761,680		1,269,300		2,030,980	65,515	109	680	96	24,570	40,945	65,515	17	28	45	29	49	78
2001	Nov.	30	609,210		1,095,200		1,704,410	56,814	95	682	83	20,307	36,507	56,814	14	25	39	24	43	68
2001	Dec.	31	450,617		1,213,800		1,664,417	53,691	89	685	78	14,536	39,155	53,691	10	27	37	17	47	64
2002	Jan.	31	587,051		1,063,700		1,650,751	53,250	89	688	77	18,937	34,313	53,250	13	24	37	23	41	63
2002	Feb.	28	534,920		969,900		1,504,820	53,744	90	690	78	19,104	34,639	53,744	13	24	37	23	41	64
2002	Mar.	31	667,479		1,153,300		1,820,779	58,735	98	695	85	21,532	37,203	58,735	15	26	41	26	44	70
2002	Apr.	30	670,558		1,186,200		1,856,758	61,892	103	692	89	22,352	39,540	61,892	16	27	43	27	47	74
2002	May	31	815,938		1,433,700		2,249,638	72,569	121	695	104	26,321	46,248	72,569	18	32	50	31	55	86
2002	June	30	1,099,304		1,942,000		3,041,304	101,377	169	698	145	36,643	64,733	101,377	25	45	70	44	77	121
2002	July	31	1,444,101		2,466,300		3,910,401	126,142	210	700	180	46,584	79,558	126,142	32	55	88	55	95	150
2002	Aug.	31	1,693,219		2,651,500		4,344,719	140,152	234	702	200	54,620	85,532	140,152	38	59	97	65	102	167
2002	Sept.	30	1,060,027		1,881,900		2,941,927	98,064	163	705	139	35,334	62,730	98,064	25	44	68	42	75	117
Totals/Averages			**10,394,104**		**18,326,800**		**28,720,904**	**78,495**	**131**		**121**	**28,403**	**50,092**	**78,495**	**20**	**35**	**55**	**34**	**60**	**93**
2002	Oct	31	714,530		1,269,300		1,983,830	63,995	107	708	90	23,049	40,945	63,995	16	28	44	27	49	76
2002	Nov.	30	636,594		969,600		1,606,194	53,540	89	710	75	21,220	32,320	53,540	15	22	37	25	38	64
2002	Dec.	31	575,806		1,163,200		1,739,006	56,097	93	713	79	18,574	37,523	56,097	13	26	39	22	45	67
2003	Jan.	31	586,070		1,010,400		1,596,470	51,499	86	715	72	18,905	32,594	51,499	13	23	36	23	39	61
2003	Feb.	28	539,686		934,800		1,474,486	52,660	88	718	73	19,275	33,386	52,660	13	23	37	23	40	63
2003	Mar.	31	825,895		1,133,000		1,958,895	63,190	105	720	88	26,642	36,548	63,190	19	25	44	32	44	75
2003	Apr.	30	670,558		1,113,700		1,784,258	59,475	99	724	82	22,352	37,123	59,475	16	26	41	27	44	71
2003	May	31	815,938		1,437,900		2,253,838	72,704	121	727	100	26,321	46,384	72,704	18	32	50	31	55	87
2003	June	30	1,032,912		2,587,600		3,620,512	120,684	201	730	165	34,430	86,253	120,684	24	60	84	41	103	144
2003	July	31	1,886,308		2,966,800		4,853,108	156,552	261	735	213	60,849	95,703	156,552	42	66	109	72	114	186
2003	Aug.	31	1,541,455		2,632,100		4,173,555	134,631	224	740	182	49,724	84,906	134,631	35	59	93	59	101	160
2003	Sept.	30	1,077,594		1,830,300		2,907,894	96,930	162	750	129	35,920	61,010	96,930	25	42	67	43	73	115
Totals/Averages			**10,903,346**		**19,048,700**		**29,952,046**	**81,830**	**136**		**102**	**29,772**	**52,058**	**81,830**	**21**	**36**	**57**	**35**	**62**	**97**
2003	Oct	31	648,800		1,062,400		1,711,200	55,200	92	760	73	20,929	34,271	55,200	15	24	38	25	41	66
2003	Nov.	30	628,964		1,028,200		1,657,164	55,239	92	770	72	20,965	34,273	55,239	15	24	38	25	41	66
2003	Dec.	31	591,737		975,700		1,567,437	50,562	84	775	65	19,088	31,474	50,562	13	22	35	23	37	60
2004	Jan.	31	673,762		1,052,400		1,726,162	55,683	93	780	71	21,734	33,948	55,683	15	24	39	26	40	66
2004	Feb.	28	626,660		1,074,600		1,701,260	60,759	101	790	77	22,381	38,379	60,759	16	27	42	27	46	72
2004	Mar.	31	662,422		1,333,900		1,996,322	64,397	107	800	80	21,368	43,029	64,397	15	30	45	25	51	77
2004	Apr.	30	754,171		1,321,200		2,075,371	69,179	115	810	85	25,139	44,040	69,179	17	31	48	30	52	82
2004	May	31	895,071		1,559,300		2,454,371	79,173	132	820	97	28,873	50,300	79,173	20	35	55	34	60	94
2004	June	30	1,148,387		2,040,000		3,188,387	106,280	177	825	129	38,280	68,000	106,280	27	47	74	46	81	127
2004	July	31	1,758,875		3,248,400		5,007,275	161,525	269	830	195	56,738	104,787	161,525	39	73	112	68	125	192
2004	Aug.	31	1,792,037	137	2,271,800	165	4,063,974	131,096	218	835	157	57,808	73,284	131,092	40	51	91	69	87	156
2004	Sept.	30	2,008,640	145	204,900	118	2,213,685	73,790	123	838	88	66,955	6,830	73,785	46	5	51	80	8	88
Totals/Averages			**12,189,526**		**17,172,800**		**29,362,608**	**80,240**	**134**		**100**	**33,355**	**46,885**	**80,239**	**23**	**33**	**56**	**40**	**56**	**96**
2004	Oct	31	821,337		1,335,600	156	2,156,937	69,579	116	840	83	26,495	43,084	69,579	18	30	48	32	51	83
2004	Nov.	30	706,073		1,156,200	146	1,862,273	62,076	103	842	74	23,536	38,540	62,076	16	27	43	28	46	74
2004	Dec.	31	239,512		1,808,200	148	2,047,712	66,055	110	844	78	7,726	58,329	66,055	5	41	46	9	69	79
2005	Jan.	31	0		2,044,500	142	2,044,500	65,952	110	846	78	0	65,952	65,952	0	46	46	0	79	79
2005	Feb.	28	577,205	135	1,368,600	140	1,945,940	69,498	116	848	82	20,614	48,879	69,493	14	34	48	25	58	83
2005	Mar.	31	799,001	130	1,235,200	139	2,034,331	65,624	109	852	77	25,774	39,845	65,619	18	28	46	31	47	78
2005	Apr.	30	921,757	143	1,239,400	135	2,161,300	72,043	120	858	84	30,725	41,313	72,039	21	29	50	37	49	86
2005	May	31	734,808	130	1,367,000	136	2,101,938	67,804	113	862	79	23,703	44,097	67,800	16	31	47	28	52	81
2005	June	30	1,039,327	141	1,286,400	133	2,325,868	77,529	129	865	90	34,644	42,880	77,524	24	30	54	41	51	92
2005	July	31	2,008,392	152	3,919,500	150	5,928,044	191,227	319	867	221	64,787	126,435	191,222	45	88	133	77	151	228
2005	Aug.	31	2,155,326	140	2,369,400	156	4,524,866	145,963	243	869	168	69,527	76,432	145,959	48	53	101	83	91	174
2005	Sept.	30	1,509,275		2,004,000	154	3,513,275	117,109	195	870	135	50,309	66,800	117,109	35	46	81	60	80	139
Totals/Averages			**11,512,013**		**21,134,000**		**32,646,984**	**89,205**	**149**		**112**	**31,487**	**57,716**	**89,202**	**22**	**40**	**62**	**37**	**69**	**106**

Note: Above figures are in gallons per month.

peak month summer water use increased from 140,000 gpd to 191,000 which is 51,000 gpd or 36 percent. This increase occurred in spite of requested water restrictions. The annual water demand per capita, however, has not increased to any significant extent over the four years. It was 121 gpcd in 2002, 102 gpcd in 2003, 100 gpcd in 2004 and 112 gpcd in 2005. It may be assumed that there is some pent up demand for landscape irrigation which will be seen next summer if water restrictions are lifted when the new well is on line. This study, however, recommends that water conservation practices be implemented on a permanent basis as recommended by the Water Resources Department of the State.

- **Summer of 2004** - Last summer (2004), water demand was taxing the wells severely. The PW Superintendent begun carefully reviewing the well performance and found their production to be much lower than previously believed. Drawdown in the wells was reaching the pump. A notice was quickly sent to all users requesting that they voluntarily reduce their water use by 20 percent of more. The demand immediately dropped by 20 percent with a drop of 41 percent from peak daily use. A similar letter was sent to all users the summer of 2005 requesting voluntary reduction in water use. The two existing wells were able to meet the summer demand in 2005. It must be assumed that after the new well is on line, summer water use will increase. The amount of increase is difficult to determine but I assume 10 percent because citizens will be requested to practice sound conservation measures as a matter of course.
- **Summer Demand** – If the summer irrigation demand is considered to be June, July, August and September, the following trend is seen:

	June	July	August	Sept.	Avg. Summer
• 2002 Average gpd	101,377	126,142	140,052	98,064	116,409
• 2003 Average gpd	120,684	156,552	134,931	96,930	127,274
• 2004 Average gpd	106,280	161,525	131,096	73,790	118,173
• 2005 Average gpd	77,529	191,227	145,963	117,109	132,957

The data above shows the monthly increases in water demand as the population has grown. July appears to be the highest water demand month of the year. Percapita water demand over these four years is as follows: 2002 – 180; 2003 – 213; 2004 – 195; 2005 – 220.

Nearly all of the new homes constructed in Aurora in recent years have been stick built middle income homes with attractive landscaped yards. It is reasonable that newer homes will receive more irrigation water than many of the older homes. Even with low flow fixtures in the homes, it could be expected that the percapita water use for these newer homes will be somewhat greater than the existing homes. The existing homes in Aurora vary from lushly landscaped fine homes on large lots to mobile or manufactured homes on very small lots with very little landscaping. It may be possible that once the new landscapes are established in the newer homes, the average water demand per capita may only be a few percentage points from pregrowth Aurora. For purposes of this report, it will be assumed that the percapita water use of new homes added from a base year of 2002 will be 10 percent greater than the earlier homes.

- **Projected population that can be served by the existing supply** – Based on the experience of the past two summers, the existing population is approaching the practical limit of the water production from the existing wells. Additional population could be served by the existing wells if mandatory water restrictions were imposed during the dry period of the summer. It would be reasonable to assume that peak summer demand without mandatory water restrictions must be met by the new well from a population of about 800 forward. Except for the peak days of the irrigation season, the existing two wells can easily meet the needs of 1,000 or more people.
- **Water addition from New Well** – The new well is scheduled for completion by G Cam Ltd over the next few weeks. Pump tests show the well is capable of pumping 200 gpm or more during the winter months; 175 gpm for daily pumping at 12 to 14 hours per day and 150 gpm for continuous summer pumping. It is always possible that these quantities will decrease with time as did the existing park wells. The new well was constructed to the highest current drilling standards and any loss in future capacity would not be caused by well development but by a declining aquifer. It is also possible for a well to loose capacity due to fouling of the aquifer or pump screens by iron or manganese bacteria (natural slimes that coat and plug openings). These can be controlled to a great extent by various well cleaning techniques conducted as maintenance projects.
- **Impact of New Well**
  - **Existing Wells** – The existing well can produce a sustainable flow of approximately 145,000 to 190,000 during the high demand month of the summer.
  - **New Well** - The new well will add a sustained daily flow of 150 gpm for a 24 hour day or up to 216,000 gallons per day or approximately 187 gpd for 14 hours per day or up to 158,000 gpd. The combined water production available to the community will be 303,000 to 406,000 gallons per day during the peak summer demand period. Using 400,000 gpd, the three wells combined will produce 278 gpm if operated continuously for 24 hours days or 476 gpm if operated 14 hours per day. To achieve maximum production from the wells, additional reservoir capacity is needed to permit the water in the reservoir to be pulled down during the peak demand period of the day and refilled an night. Doing this currently seriously reduced the limited fire storage in the reservoirs during these drawdown periods.
  - **Projected Population that could be served by the three wells –**
    - **Existing Demand** – The existing monthly percapita water demand varies from 77 gpd during the winter to 220 gpd during the highest irrigation month. The current annual average daily demand is approximately 115 gpcd (gallons per capita per day).

- **Future Demands from existing water master plan** - The current 1996 Aurora water master plan uses 130 gpcd for the average annual demand. It uses 163 gpcd for the peak daily demand (peaking factor of 1.25). It projects a maximum daily demand of 185,168 gpd for a projected future population of 1,136 people. If these figures were used, the maximum daily water demand for the build-out population projection of 1,214 people would be 197,882 gallons per day. The existing 870 Aurora population required 191,227 average gallons per day for the entire month of July 2005, and this under voluntary water restrictions.
- **Future Demands projected in this study** - The normal peaking factor for peak domestic maximum daily loading is 2.5. This figure varies between 2.0 and 2.5 depending on the community. A corresponding peaking factor for maximum month is 1.8 to 2.0. Before water conservation, Aurora's peaking factor for maximum monthly demand was 1.85. In 2005 it was 2.14. For this study, a maximum monthly peaking factor of 2.0 will be used. This figure anticipates a significant irrigation loading from the new homes being constructed.
- **Projected future water demand** –
  - **Projection Base** - The projection will begin with the existing 2005 demand which is 191, 225 gallons per day for the maximum month of the year and 89,200 gallons per day average for the entire year.
  - **Average Annual Projection** – The average percapita demand for the past two years is 106 gallons per day. 2005 was 112 gpcd. For this study, 120 gpcd will be used for the new users.
  - **Maximum Month Projection** – 2.0 times 120 is 240 gallons per capita per day at for the peak summer month. Total well production is estimated in this report to be 400,000 gpd. If existing users require 191,225 gallons, the remainder for growth is 208,775 gpd. At 240 gpcd, the added population above the existing 870 is another 870 people for a total of 1,740. The annual monthly water demand will be 178,400 which is considerably below the available 400,000 gpd. Once again, this assumes added reservoir capacity to permit reservoir drawdown during the peak demand hours.
  - **Maximum Growth Beyond Build-out** – Aurora population after build-out of existing approved lots is projected in this report at 1,214 people. It will therefore be possible to add 526 people (188 housing units) to the city before the water system begins reaching its maximum demand and water restriction will be required to hold down peak summer loadings. It should be noted

that this projections of population and housing units could be reduced if well production deteriorates over time.

With summer water use restrictions, a population of nearly 3,000 people could be supplied with domestic water from the available water source. (example, in the mid 1990's, the city of Dayton supplied 1550 people with a water supply of 231,000 gallons per day (with 800,000 gallons of reservoir capacity) and the city of Lafayette supplied 1,325 people with 165,000 gpd (500,000 gallons of reservoir capacity). Many other cities can provide similar numbers. Using the Lafayette example a supply of 400,000 gpd could provide water for up to 3,200 people but odd/even summer water restrictions would be required.

- **Water Conservation** – All Oregon cities are required to conduct a program of educating the citizens of the need for water conservation and supply them tools to help implement the program. A strong program will lower the water demand and extend the time until a second new well will be required. Initiating this program is critical to providing long term water supply for the city.

- **Well Planning** – Over the next 5 to 15 years, it will be necessary to fully plan for a second new well and secure the needed water rights for that well. Water rights for a second new well may take extreme effort and considerable time to achieve. It is advised that acquiring water rights become a priority for the city and an active program be set up to achieve this. If time shows deterioration of the supply from the three wells, it may become necessary to accelerate this program and secure the water rights and drill the well at an earlier date. Timing is difficult to predict as it depends both on the rate of city growth and how stable the water supply is over time.

- **Water Consumption**

Water consumption data was provided by City Staff. This data is presented on **Table 7**. Several conclusions and trends can be seen from this data:

- **Total City Use** - One year of total flow data was corrupted by the billing computer (unless people are using 3 to 4 times more water than Bob is producing).
- **Water Loss** – There seems to be a trend toward increasing water loss but this may be un-metered water for city use such as park watering. Without the data from the missing year, this trend can not be verified.
- **Persons per Water Service** – This has been holding at about 2.32 people per water service. This figure is lower that people per house because many water services are for businesses or similar purpose.
- **Large users** – The two largest users are the Hazelnut Candy factory, the post office and the Fire Department house. These three users combined

Table 7

CITY OF AURORA

LARGEST WATER USER DATA

By Billing Cycle

User Consumption - cubic feet	6-24-03 to 8-28-03	8-29-03 to 10-25-03	10-26-03 to 12-28-03	12-29-03 to 2-26-04	2-27-04 to 4-28-04	4-29-04 to 6-24-04	6-25-04 to 8-28-04	8-29-04 to 10-25-04	10-26-04 to 12-28-04	12-29-04 to 2-26-05	2-27-05 to 4-28-05	4-29-05 to 6-23-05	6-24-05 to 8-27-05
Total City Water Use Analysis													
Approximate Water Production - cf	1,206,773	617,526	431,096	458,211	544,344	754,379	1,212,734	584,308	522,725	533,481	560,913	591,953	1,397,448
Approximate Wastewater Influent	-	-	-	330,214	341,711	351,604	380,481	370,722	389,439	381,150	370,856	376,337	388,770
Total City Consumption (meters) - cf	1,081,565	544,874	(error)	11,611,891	3,354,956	12,441,911	4,489,218	8,633,405	454,260	385,744	416,883	502,445	906,974
% of unmetered consumption>	10.4	11.8		-	-	-	-	-	13.1	27.7	25.7	15.1	35.1
Analysis of Water Services													
Number of water service accounts>	316	324	324	335	342	351	355	363	361	360	370	375	375
Estimated population>	735	750	770	780	800	820	830	838	842	846	852	862	870
People per service>	2.33	2.31	2.38	2.33	2.34	2.34	2.34	2.31	2.33	2.35	2.30	2.30	2.32

Individual Largest Users													
Aurora Fire Department (house)	4,072	12,647	13,202	734	865	5,266	15,451	4,628	866	2,386	9,384	804	13,457
% of Total>	0.38	2.32	-	-	-	-	-	-	0.19	0.62	2.25	0.16	1.48
Aurora Post Office	11,925	10,891	381	406	4,657	5,832	16,334	31,821	7,959	333	4,647	5,832	16,334
% of Total>	1.10	2.00	-	-	-	-	-	-	1.75	0.09	1.11	1.16	1.80
Pacifie Hazelnut Candy Factory	3,700	10,008	11,534	4,612	5,418	8,159	1,640	17,097	11,534	2,320	3,495	7,328	11,526
% of Total>	0.34	1.84	-	-	-	-	-	-	2.54	0.60	0.84	1.46	1.27
Practical Gourmet, Inc.	71	16	1,201	2,180	2,468	1,608	2,156	2,036	2,455	2,565	1,906	2,195	2,027
% of Total>	0.01	0.00	-	-	-	-	-	-	0.54	0.66	0.46	0.44	0.22
The Colony Pub	-	-	-	-	-	-	-	5,796	5,704	4,709	4,732	5,378	9,731
% of Total>	-	-	-	-	-	-	-	0.07	1.26	1.22	1.14	1.07	1.07

(shaded)	Water consumption data error
-	Accurate data not available

represents only about 4 to 5 percent of the city water production. This indicates that domestic residential use represents most (likely 85 to 90 percent) of the water use.

- **Water Production/Use vs. Wastewater Influent** – During the winter months it can be seen that a very high percentage of the metered water used is received at the wastewater plant (January & February 2005 it was 98.9 percent). During the irrigation season, this percentage drops to between 35 and 50 percent. During this period in early 2005, 13.1 percent of the water produced did not pass through water meters to users.

- **Transmission and Distribution main sizing**

  - **General Pipe Sizing Requirements -** Adequately sized water pipes are needed from the storage reservoir to all parts of the community. These lines provide water for domestic use, irrigation and fire fighting. Fire fighting makes the highest demands on the piping system. The water distribution system should provide a minimum 1,500 gpm supply to all hydrants in the system. It is desirable that between 3,000 and 5,000 gpm per hydrant is provided in commercial and industrial areas to meet the fire fighting demands of larger buildings; however this is very difficult for small communities to fund. Large mains (10 and 12-inch) are needed adjacent to commercial and industrial areas and an 8-inch water main grid is required to provide fire flows to the residential areas. Six inch mains are adequate for short dead end lines like cul-de-sacs and looped lines not exceeding 1000 feet between 8-inch lines.

  - **Past EAS Recommendations -** In the past, EAS has recommend a 10 or 12-inch pipe along Highway 99 from Ottaway Rd. to Second St. looped to a 10-inch on Liberty. This will provide a tie between reservoirs (assuming a future NW Aurora reservoir) and will greatly improve fire flows south of Mill Creek and the railroad. The 10-inch Liberty Street main was recently constructed by G. Cam Ltd as part of an annexation package for the VanLieu property. This line alone has provided a major improvement in the fire flows to the portion of the city south of the Ehlen Road bridge and has also greatly reduced pressure drops to most homes during periods of heavy water use.

  - **Northwest Aurora -** If northwest Aurora is not to grow beyond the existing UGB, the existing distribution system will provide domestic flows and very minimal fire flows. The relatively new 6-inch line in Airport Road and the new 8-inch line in Ehlen Road greatly limits fire flows to this area. There has been discussion that Aurora, in time, may expand the UGB and city limits to and around the airport which will greatly expand the water distribution system in the northwest portion of the city.

    A second reservoir will be needed in this area as recommended in the master plan however its 100,000 gallon recommended size should be reevaluated as a much larger reservoir would be needed. With the reservoir in place, larger water mains will be needed to get the water from the reservoir to the fire hydrants to provide fire protection, particularly for the industrial property to the north.

A hydraulic model of the city will be needed to project pipe sizes if a northwest expansion is to be considered however, a larger water main will be needed on the upper portion of Airport Road at a minimum (below the new reservoir) to provide fire protection to the existing properties in the area plus new developments that may be constructed. A larger main crossing the river may not be needed until well beyond the 20 year planning period, if a new NW Aurora reservoir and related piping are constructed. The reservoir can provide the daily peak water demands and the reservoir can be refilled an night during low demand periods using the existing 8 inch main across the river (Mill Creek).

- **Distribution Summary**
  - **City-wide Need** - The need currently exists for sound and larger water lines throughout the community. Although the new 10-inch main in Liberty Street has greatly improved fire flows between Ottaway Road and the downtown, many remaining existing lines are undersized galvanized iron, steel or AC pipes which have reached the end of their useful life. In addition, a large diameter pipe loop is needed to reinforce the grid north of Ottaway Road. This project will become a high priority if increased commercial or industrial developments are located in and around the downtown.
  - **Design Standard** - It is my recommendation that 8-inch be the smallest size permitted for the new water lines that make up the system grid. 6-inch lines can be used for short private streets used in infill situations but even these should be looped back to 8-inch pipes where possible.
  - **Needed Projects** - My suggested water main extensions appeared on a brief city wide CIP drafted in 2002, however, a new water master plan is needed where the areas of potential growth and UGB expansion are evaluated and the system is hydraulically modeled by computer.
- **Distribution Recommendations**
  - **Master Plan** - Update the water master plan.
  - **Large Diameter Loop** - Construct a 10 or 12 inch line on Highway 99 to loop the main grid and provide improved flow to the commercial and industrial areas of the city.
  - **Replacements** - Continue an ongoing program of water main replacements.
  - **Standards** - Continue with the 8-inch minimum pipe size for new construction (except short non-grid sections where 6 inch lines are used).

- **Storage and Pumping** – A minimum of one new ground level reservoir is needed in Aurora at the present time. A second reservoir is also needed in NW Aurora as recommended in the master plan but its size needs reconsideration. This reservoir need will increase over time. Reservoir capacity can be calculated by the following formula:
  - **Formula** - S (storage) = Emergency + Equalization + Fire

- **Size** - For 1,214 people (build-out of existing approved lots) this translates to:
  - Emergency = (2)(ADD) = (2)(125)(1214) = 303,000 gal
  - Equalization = (0.25)(MDD) = (.25)(300)(1214) = 91,000
  - Fire = 4 hrs @ 2,500 gpm = 600,000
    (This normal design for commercial and small industrial fire – a minimum)
  - Total storage = 994,000 gal
  - Existing storage = 300,000 gal
  - Required storage = 694,000 gal
- **Projected** - If projected 1,800 population is used, this becomes - 900,000 gal - Note: Dayton, where I am city engineer, has 2.4 MG Storage with population of 2,300
- **Sizing Options** - The existing master plan uses 1,200 gpm for 2 hours for fire flows. This equals 144,000 gallons of fire storage. In past water master plans I have used both 3,500 gpm for 4 hours and 1,500 for 4 hours. These translate to 840,000 and 360,000 gallons respectively. Under any scenario, the existing tank is too small for today's need let alone future demand. A new reservoir should be programmed for construction as soon as economically feasible. In my opinion, the minimum size to be considered should be 500,000 gallon. A larger tank at say 750,000 gallons would be a more reasonable design. The absolute minimum volume that should be considered is the G. Cam Ltd planned 300,000 gallon tank (funds for reservoir shifted to the new well but new reservoir is still under consideration using SDC funds). With the smaller tank above and an additional reservoir in NW Aurora, the city will have a bare minimum reservoir capacity for a city of its projected size.
- **Pump Station** - If the new reservoir is not located adjacent to the existing one, a new pump station is also needed. This facility will provide water pumping for domestic use plus a high volume fire pump. If the new reservoir is located near the existing tank, the existing pump station can be used for both. The existing pump station is undergoing a control system modernization which should permit it to remain in service for an additional 10 to 15 years.
- **Reservoir Siting** - The siting of the next reservoir is very important to distribution of fire flows. It should be connected to the grid with a 12 inch main and from there be tied to 10-inch and 8-inch mains to permit feeding all hydrants efficiently form both reservoirs. In addition, the hydrants should be fed from two directions where possible. EAS's original recommend was not to site the new reservoir adjacent to the existing tank as it is fed by a 10-inch main to the grid however if it is sited there, a new larger main should be included to Highway 99E. An optional location further north could also be considered but, as noted above, a reservoir at a different location will require a new pump station which will be a significant cost. The new wastewater plant site could be considered if the tie to the grid is north of Bob's Street but mixing water and wastewater at the same site is not advised. In addition, every square inch of the existing wastewater site may be needed for

expansion. The G. Cam Ltd plan to add a 300,000 gallon tank next to the existing one was considered acceptable as the funds were outside the normal city water revenues from SDC's or user rates. If SDC funds are used, this project should be reconsidered. The city needs a new reservoir. Any project that provides the needed storage in a manner compatible with the water system when the city grows should be considered.

- **Planning & Construction Underway** – Considerable effort has been expended on planning and upgrading the water system over the past two years. EAS prepared several review analysis of the system. These reviews focused on water supply, water storage and distribution of the water from the reservoir to users throughout the city and particularly for basic fire protection throughout the city. Following is a summary of the recommendations and resulting actions underway:
  - **Supply** – With the discovery of lower than expected summer 2004 well production and direction from the Mayor, Bill Carr, the following actions were taken:
    - **Project Revision** - The offsite improvements attached to the VanLieu subdivision were modified, shifting from a new reservoir to a new well.

      A detailed report was completed by EAS recommending the shift to from the reservoir to the well and Groundwater Solutions Inc was hired as a subconsultant to determine the feasibility of a new well, to determine the appropriate location, to estimate the water production of a new well and to prepare bid documents to assist G Cam Ltd in securing a contractor.
    - **Well Construction** - In early April, 2005 GeoTech Solutions was selected by Georgi Cam to drill a new well.
    - **Well Location** - The well was sited on a planned lot within the Keil Park 2 subdivision which is located adjacent to the Keil Park 1 subdivision south of Ottaway road. The drilling of this well was completed in June and design of the well house and related improvements were undertaken. This design has been completed and the city is currently awaiting State and County approval to proceed with construction.
    - **Well Completion** - The final pending well project is to fit the well with a pump, pump house and chlorination system. The dedicated supply main to Ottaway Road has been completed. If the remaining work proceeds in a timely manner, the new well should be providing water to the community in early 2006.
    - **Well Flow** - The output of this well is assumed to be between 200 and 300 gpm. Pump tests show the well will provide between 150 and 200 gpm depending on how hard the aquifer is worked. This is because the water bearing aquifer was found to be smaller than anticipated at this location which is separated by nearly 2000 feet from other production wells, a distance designed to minimize interference between wells.
  - **Water Distribution and Pumping**

- **Liberty St Main** - The 10-inch Liberty Street has been constructed and water services transferred to the new main allowing the old undersized main to be abandoned. This one improvement has eliminated most of the low pressure areas of the city and has provided adequate fire flows down the spine of the city from the downtown to Ottaway Road.
- **Other Distribution Needs** - There are many other water distribution needs throughout the city which must be addressed as the city continues to grow. The Liberty Street project combined with the recently completed Ottaway Road 10 inch pipe extension from Main to Liberty completes the most critical water distribution projects. The next step will be to continue the main replacement program by replacing the highest priority remaining main replacement projects as funds become available. Constructing a new large diameter main on Highway 99 should be programmed as soon as economically feasible.
- **Water Pumping** - Water is supplied to the city from the reservoir by a pump station located on Ottaway Road next to the reservoir. Recent review of this facility showed the control system severely out of date and partially dysfunctional. Work is underway to modernize the controls and instrumentation and to return the fire pump to automatic service. Other updates to this facility will be needed at the city continues to grow.

o **Water Storage**

- **Immediate** – The construction of a new 300,000 gallon reservoir adjacent to the existing tank has been placed on hold until the water well project has been completed, or at lease until all costs are known.
- **Near Future** – Use of the water SDC fees collected from the four G Cam Ltd subdivisions are not anticipated to be used for the two off-site water improvements by Mr. Cam; the Liberty Street water line and the new well, although all well cost are not yet known. With the remaining SDC funds from these projects plus the other funds in the water SDC account, other city wide projects can be considered. It is anticipated that the new reservoir will be constructed using SDC funds. SDC funds can also be used to upsize undersized water mains. Water system needs will receive additional study by the city Council before the SDC funds are used however, construction of the reservoir is anticipated.

o **Water Treatment**

- **Chlorination** – Currently, chlorination is the only treatment applied to the city's well water supply. The water meets the Oregon State Drinking Water standards without any further treatment. Water quality in the new well was found not to require treatment. As additional wells are added, treatment of water from one or more new wells may be required but technology exists to treat the water at the well site thereby nor requiring a large municipal water treatment plant. The city should monitor the trends in water testing requirements plus publications produced by the State to determine if water treatment may become required in the future.

APPENDIX

I Selections from the Aurora 2000 Census

II Schedule A from the Aurora DEQ NPDES Permit

Table DP-1. Profile of General Demographic Characteristics: 2000

Geographic Area: Aurora city, Oregon

[For information on confidentiality protection, nonsampling error, and definitions, see text]

Subject	Number	Percent	Subject	Number	Percent
Total population	**655**	**100.0**	HISPANIC OR LATINO AND RACE		
			Total population	**655**	**100.0**
SEX AND AGE			Hispanic or Latino (of any race)	41	6.3
Male	336	51.3	Mexican	39	6.0
Female	319	48.7	Puerto Rican	-	-
Under 5 years	47	7.2	Cuban	-	-
5 to 9 years	49	7.5	Other Hispanic or Latino	2	0.3
10 to 14 years	40	6.1	Not Hispanic or Latino	614	93.7
15 to 19 years	39	6.0	White alone	595	90.8
20 to 24 years	31	4.7	RELATIONSHIP		
25 to 34 years	65	9.9	**Total population**	**655**	**100.0**
35 to 44 years	117	17.9	In households	655	100.0
45 to 54 years	128	19.5	Householder	250	38.2
55 to 59 years	34	5.2	Spouse	156	23.8
60 to 64 years	19	2.9	Child	192	29.3
65 to 74 years	48	7.3	Own child under 18 years	147	22.4
75 to 84 years	30	4.6	Other relatives	25	3.8
85 years and over	8	1.2	Under 18 years	9	1.4
Median age (years)	40.7	(X)	Nonrelatives	32	4.9
			Unmarried partner	7	1.1
18 years and over	495	75.6	In group quarters	-	-
Male	245	37.4	Institutionalized population	-	-
Female	250	38.2	Noninstitutionalized population	-	-
21 years and over	476	72.7			
62 years and over	97	14.8	HOUSEHOLD BY TYPE		
65 years and over	86	13.1	**Total households**	**250**	**100.0**
Male	37	5.6	Family households (families)	186	74.4
Female	49	7.5	With own children under 18 years	79	31.6
			Married-couple family	156	62.4
RACE			With own children under 18 years	66	26.4
One race	644	98.3	Female householder, no husband present	18	7.2
White	617	94.2	With own children under 18 years	8	3.2
Black or African American	3	0.5	Nonfamily households	64	25.6
American Indian and Alaska Native	4	0.6	Householder living alone	49	19.6
Asian	7	1.1	Householder 65 years and over	23	9.2
Asian Indian	-	-			
Chinese	3	0.5	Households with individuals under 18 years	84	33.6
Filipino	-	-	Households with individuals 65 years and over	64	25.6
Japanese	-	-			
Korean	4	0.6	Average household size	2.62	(X)
Vietnamese	-	-	Average family size	3.01	(X)
Other Asian [1]	-	-			
Native Hawaiian and Other Pacific Islander	-	-	HOUSING OCCUPANCY		
Native Hawaiian	-	-	**Total housing units**	**262**	**100.0**
Guamanian or Chamorro	-	-	Occupied housing units	250	95.4
Samoan	-	-	Vacant housing units	12	4.6
Other Pacific Islander [2]	-	-	For seasonal, recreational, or occasional use	1	0.4
Some other race	13	2.0			
Two or more races	11	1.7	Homeowner vacancy rate (percent)	0.9	(X)
			Rental vacancy rate (percent)	9.5	(X)
Race alone or in combination with one or more other races: [3]					
			HOUSING TENURE		
White	626	95.6	**Occupied housing units**	**250**	**100.0**
Black or African American	9	1.4	Owner-occupied housing units	212	84.8
American Indian and Alaska Native	4	0.6	Renter-occupied housing units	38	15.2
Asian	12	1.8			
Native Hawaiian and Other Pacific Islander	2	0.3	Average household size of owner-occupied units	2.53	(X)
Some other race	13	2.0	Average household size of renter-occupied units	3.11	(X)

- Represents zero or rounds to zero. (X) Not applicable.

[1] Other Asian alone, or two or more Asian categories.

[2] Other Pacific Islander alone, or two or more Native Hawaiian and Other Pacific Islander categories.

[3] In combination with one or more of the other races listed. The six numbers may add to more than the total population and the six percentages may add to more than 100 percent because individuals may report more than one race.

Source: U.S. Census Bureau, Census 2000.

Table DP-2. Profile of Selected Social Characteristics: 2000

Geographic area: Aurora city, Oregon

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent
SCHOOL ENROLLMENT		
Population 3 years and over enrolled in school	**141**	**100.0**
Nursery school, preschool	10	7.1
Kindergarten	17	12.1
Elementary school (grades 1-8)	72	51.1
High school (grades 9-12)	14	9.9
College or graduate school	28	19.9
EDUCATIONAL ATTAINMENT		
Population 25 years and over	**404**	**100.0**
Less than 9th grade	12	3.0
9th to 12th grade, no diploma	17	4.2
High school graduate (includes equivalency)	99	24.5
Some college, no degree	91	22.5
Associate degree	20	5.0
Bachelor's degree	124	30.7
Graduate or professional degree	41	10.1
Percent high school graduate or higher	92.8	(X)
Percent bachelor's degree or higher	40.8	(X)
MARITAL STATUS		
Population 15 years and over	**453**	**100.0**
Never married	76	16.8
Now married, except separated	293	64.7
Separated	3	0.7
Widowed	42	9.3
Female	36	7.9
Divorced	39	8.6
Female	15	3.3
GRANDPARENTS AS CAREGIVERS		
Grandparent living in household with one or more own grandchildren under 18 years	**11**	**100.0**
Grandparent responsible for grandchildren	-	-
VETERAN STATUS		
Civilian population 18 years and over	**441**	**100.0**
Civilian veterans	75	17.0
DISABILITY STATUS OF THE CIVILIAN NONINSTITUTIONALIZED POPULATION		
Population 5 to 20 years	**150**	**100.0**
With a disability	12	8.0
Population 21 to 64 years	**347**	**100.0**
With a disability	56	16.1
Percent employed	57.1	(X)
No disability	291	83.9
Percent employed	83.8	(X)
Population 65 years and over	**80**	**100.0**
With a disability	28	35.0
RESIDENCE IN 1995		
Population 5 years and over	**577**	**100.0**
Same house in 1995	233	40.4
Different house in the U.S. in 1995	342	59.3
Same county	149	25.8
Different county	193	33.4
Same state	136	23.6
Different state	57	9.9
Elsewhere in 1995	2	0.3

Subject	Number	Percent
NATIVITY AND PLACE OF BIRTH		
Total population	**637**	**100.0**
Native	602	94.5
Born in United States	602	94.5
State of residence	354	55.6
Different state	248	38.9
Born outside United States	-	-
Foreign born	35	5.5
Entered 1990 to March 2000	6	0.9
Naturalized citizen	9	1.4
Not a citizen	26	4.1
REGION OF BIRTH OF FOREIGN BORN		
Total (excluding born at sea)	**35**	**100.0**
Europe	2	5.7
Asia	15	42.9
Africa	-	-
Oceania	-	-
Latin America	10	28.6
Northern America	8	22.9
LANGUAGE SPOKEN AT HOME		
Population 5 years and over	**577**	**100.0**
English only	545	94.5
Language other than English	32	5.5
Speak English less than "very well"	22	3.8
Spanish	14	2.4
Speak English less than "very well"	11	1.9
Other Indo-European languages	3	0.5
Speak English less than "very well"	-	-
Asian and Pacific Island languages	15	2.6
Speak English less than "very well"	11	1.9
ANCESTRY (single or multiple)		
Total population	**637**	**100.0**
Total ancestries reported	*804*	*126.2*
Arab	-	-
Czech[1]	2	0.3
Danish	6	0.9
Dutch	12	1.9
English	117	18.4
French (except Basque)[1]	30	4.7
French Canadian[1]	2	0.3
German	217	34.1
Greek	5	0.8
Hungarian	2	0.3
Irish[1]	95	14.9
Italian	29	4.6
Lithuanian	-	-
Norwegian	77	12.1
Polish	4	0.6
Portuguese	-	-
Russian	7	1.1
Scotch-Irish	8	1.3
Scottish	64	10.0
Slovak	-	-
Subsaharan African	-	-
Swedish	10	1.6
Swiss	2	0.3
Ukrainian	-	-
United States or American	16	2.5
Welsh	10	1.6
West Indian (excluding Hispanic groups)	-	-
Other ancestries	89	14.0

-Represents zero or rounds to zero. (X) Not applicable.

[1]The data represent a combination of two ancestries shown separately in Summary File 3. Czech includes Czechoslovakian. French includes Alsatian. French Canadian includes Acadian/Cajun. Irish includes Celtic.

Source: U.S. Bureau of the Census, Census 2000.

Table DP-3. Profile of Selected Economic Characteristics: 2000

Geographic area: Aurora city, Oregon

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent
EMPLOYMENT STATUS		
Population 16 years and over	451	100.0
In labor force	306	67.8
Civilian labor force	306	67.8
Employed	295	65.4
Unemployed	11	2.4
Percent of civilian labor force	3.6	(X)
Armed Forces	-	-
Not in labor force	145	32.2
Females 16 years and over	237	100.0
In labor force	127	53.6
Civilian labor force	127	53.6
Employed	120	50.6
Own children under 6 years	92	100.0
All parents in family in labor force	39	42.4
COMMUTING TO WORK		
Workers 16 years and over	292	100.0
Car, truck, or van - - drove alone	223	76.4
Car, truck, or van - - carpooled	32	11.0
Public transportation (including taxicab)	-	-
Walked	10	3.4
Other means	2	0.7
Worked at home	25	8.6
Mean travel time to work (minutes)[1]	24.3	(X)
Employed civilian population 16 years and over	295	100.0
OCCUPATION		
Management, professional, and related occupations	128	43.4
Service occupations	26	8.8
Sales and office occupations	83	28.1
Farming, fishing, and forestry occupations	3	1.0
Construction, extraction, and maintenance occupations	22	7.5
Production, transportation, and material moving occupations	33	11.2
INDUSTRY		
Agriculture, forestry, fishing and hunting, and mining	9	3.1
Construction	27	9.2
Manufacturing	46	15.6
Wholesale trade	5	1.7
Retail trade	54	18.3
Transportation and warehousing, and utilities	16	5.4
Information	8	2.7
Finance, insurance, real estate, and rental and leasing	21	7.1
Professional, scientific, management, administrative, and waste management services	13	4.4
Educational, health and social services	61	20.7
Arts, entertainment, recreation, accommodation and food services	8	2.7
Other services (except public administration)	5	1.7
Public administration	22	7.5
CLASS OF WORKER		
Private wage and salary workers	186	63.1
Government workers	66	22.4
Self-employed workers in own not incorporated business	41	13.9
Unpaid family workers	2	0.7

Subject	Number	Percent
INCOME IN 1999		
Households	209	100.0
Less than $10,000	8	3.8
$10,000 to $14,999	2	1.0
$15,000 to $24,999	20	9.6
$25,000 to $34,999	23	11.0
$35,000 to $49,999	32	15.3
$50,000 to $74,999	52	24.9
$75,000 to $99,999	27	12.9
$100,000 to $149,999	28	13.4
$150,000 to $199,999	9	4.3
$200,000 or more	8	3.8
Median household income (dollars)	55,938	(X)
With earnings	168	80.4
Mean earnings (dollars)[1]	77,352	(X)
With Social Security income	69	33.0
Mean Social Security income (dollars)[1]	13,018	(X)
With Supplemental Security Income	7	3.3
Mean Supplemental Security Income (dollars)[1]	8,986	(X)
With public assistance income	1	0.5
Mean public assistance income (dollars)[1]	5,000	(X)
With retirement income	45	21.5
Mean retirement income (dollars)[1]	14,303	(X)
Families	152	100.0
Less than $10,000	-	-
$10,000 to $14,999	-	-
$15,000 to $24,999	10	6.6
$25,000 to $34,999	8	5.3
$35,000 to $49,999	23	15.1
$50,000 to $74,999	44	28.9
$75,000 to $99,999	26	17.1
$100,000 to $149,999	30	19.7
$150,000 to $199,999	5	3.3
$200,000 or more	6	3.9
Median family income (dollars)	65,556	(X)
Per capita income (dollars)[1]	24,839	(X)
Median earnings (dollars):		
Male full-time, year-round workers	45,938	(X)
Female full-time, year-round workers	29,444	(X)

Subject	Number below poverty level	Percent below poverty level
POVERTY STATUS IN 1999		
Families	-	-
With related children under 18 years	-	-
With related children under 5 years	-	-
Families with female householder, no husband present	-	-
With related children under 18 years	-	-
With related children under 5 years	-	-
Individuals	10	1.6
18 years and over	10	2.3
65 years and over	6	7.5
Related children under 18 years	-	-
Related children 5 to 17 years	-	-
Unrelated individuals 15 years and over	10	12.2

-Represents zero or rounds to zero. (X) Not applicable.

[1]If the denominator of a mean value or per capita value is less than 30, then that value is calculated using a rounded aggregate in the numerator. See text.

Source: U.S. Bureau of the Census, Census 2000.

Table DP-4. Profile of Selected Housing Characteristics: 2000

Geographic area: Aurora city, Oregon

[Data based on a sample. For information on confidentiality protection, sampling error, nonsampling error, and definitions, see text]

Subject	Number	Percent
Total housing units	**240**	**100.0**
UNITS IN STRUCTURE		
1-unit, detached	185	77.1
1-unit, attached	6	2.5
2 units	2	0.8
3 or 4 units	6	2.5
5 to 9 units	-	-
10 to 19 units	-	-
20 or more units	-	-
Mobile home	41	17.1
Boat, RV, van, etc	-	-
YEAR STRUCTURE BUILT		
1999 to March 2000	5	2.1
1995 to 1998	22	9.2
1990 to 1994	29	12.1
1980 to 1989	16	6.7
1970 to 1979	74	30.8
1960 to 1969	29	12.1
1940 to 1959	22	9.2
1939 or earlier	43	17.9
ROOMS		
1 room	-	-
2 rooms	4	1.7
3 rooms	17	7.1
4 rooms	21	8.8
5 rooms	36	15.0
6 rooms	49	20.4
7 rooms	45	18.8
8 rooms	31	12.9
9 or more rooms	37	15.4
Median (rooms)	6.4	(X)
Occupied housing units	**222**	**100.0**
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	28	12.6
1995 to 1998	92	41.4
1990 to 1994	39	17.6
1980 to 1989	34	15.3
1970 to 1979	29	13.1
1969 or earlier	-	-
VEHICLES AVAILABLE		
None	4	1.8
1	52	23.4
2	103	46.4
3 or more	63	28.4
HOUSE HEATING FUEL		
Utility gas	132	59.5
Bottled, tank, or LP gas	2	0.9
Electricity	73	32.9
Fuel oil, kerosene, etc	4	1.8
Coal or coke	-	-
Wood	11	5.0
Solar energy	-	-
Other fuel	-	-
No fuel used	-	-
SELECTED CHARACTERISTICS		
Lacking complete plumbing facilities	-	-
Lacking complete kitchen facilities	-	-
No telephone service	-	-

Subject	Number	Percent
OCCUPANTS PER ROOM		
Occupied housing units	**222**	**100.0**
1.00 or less	215	96.8
1.01 to 1.50	6	2.7
1.51 or more	1	0.5
Specified owner-occupied units	**145**	**100.0**
VALUE		
Less than $50,000	3	2.1
$50,000 to $99,999	2	1.4
$100,000 to $149,999	31	21.4
$150,000 to $199,999	34	23.4
$200,000 to $299,999	54	37.2
$300,000 to $499,999	21	14.5
$500,000 to $999,999	-	-
$1,000,000 or more	-	-
Median (dollars)	203,800	(X)
MORTGAGE STATUS AND SELECTED MONTHLY OWNER COSTS		
With a mortgage	109	75.2
Less than $300	-	-
$300 to $499	3	2.1
$500 to $699	7	4.8
$700 to $999	14	9.7
$1,000 to $1,499	29	20.0
$1,500 to $1,999	48	33.1
$2,000 or more	8	5.5
Median (dollars)	1,508	(X)
Not mortgaged	36	24.8
Median (dollars)	386	(X)
SELECTED MONTHLY OWNER COSTS AS A PERCENTAGE OF HOUSEHOLD INCOME IN 1999		
Less than 15.0 percent	33	22.8
15.0 to 19.9 percent	18	12.4
20.0 to 24.9 percent	39	26.9
25.0 to 29.9 percent	17	11.7
30.0 to 34.9 percent	17	11.7
35.0 percent or more	21	14.5
Not computed	-	-
Specified renter-occupied units	**35**	**100.0**
GROSS RENT		
Less than $200	-	-
$200 to $299	-	-
$300 to $499	6	17.1
$500 to $749	8	22.9
$750 to $999	5	14.3
$1,000 to $1,499	10	28.6
$1,500 or more	-	-
No cash rent	6	17.1
Median (dollars)	810	(X)
GROSS RENT AS A PERCENTAGE OF HOUSEHOLD INCOME IN 1999		
Less than 15.0 percent	2	5.7
15.0 to 19.9 percent	8	22.9
20.0 to 24.9 percent	4	11.4
25.0 to 29.9 percent	4	11.4
30.0 to 34.9 percent	-	-
35.0 percent or more	11	31.4
Not computed	6	17.1

-Represents zero or rounds to zero. (X) Not applicable.

Source: U.S. Bureau of the Census, Census 2000.

SCHEDULE A

1. **Waste Discharge Limitations not to be exceeded after permit issuance.**

a. Treated Effluent Outfall 001

(1) May 1 - October 31: No discharge to waters of the State (unless approved in writing by the Department)

(2) November 1 - April 30:

Parameter	Average Effluent Concentrations Monthly	Average Effluent Concentrations Weekly	Monthly* Average lb/day	Weekly* Average lb/day	Daily* Maximum lbs
BOD_5	30 mg/L	45 mg/L	30	60	140
TSS	50 mg/L	80 mg/L	47	90	220

* Average dry weather design flow to the facility equals 0.079 MGD. Mass load limits have been calculated based on the maximum flows with a two year recurrence interval and the capability of the treatment works at those flows.

(3)

Other parameters (year-round)	Limitations
E. coli Bacteria	Shall not exceed 126 organisms per 100 mL monthly geometric mean. No single sample shall exceed 406 organisms per 100 mL. (See Note 1)
pH	Shall be within the range of 6.0 - 9.0
BOD_5 and TSS Removal Efficiency	Shall not be less than 85% monthly average for BOD_5 and 65% monthly for TSS.
Total Residual Chlorine	Shall not exceed a monthly average concentration of 0.08 mg/l and a daily maximum concentration of 0.20 mg/l (See Note 2).

(4) Except as provided for in OAR 340-045-0080, no wastes shall be discharged and no activities shall be conducted which violate Water Quality Standards as adopted in OAR 340-041 except in the following defined mixing zone:

The allowable mixing zone shall not exceed that portion of the Pudding River extending from a point ten feet upstream of the outfall to a point 25 feet from the east bank of the river and to a point 108 feet downstream from the outfall. The Zone of Immediate Dilution (ZID) shall be defined as that portion of the allowable mixing zone that is within ten feet of the outfall discharge port(s).

b. Reclaimed Wastewater Outfall 002

(1) November 1 – April 30: No land application is permitted (unless approved in writing by the Department.