CHAPTER FOUR
ENVIRONMENTAL

NATURAL RESOURCES

State of Condition. The Ames urbanized area is characterized by relatively intense development. The higher residential densities and non-residential floor area intensities are due, in part, to the limited amount of developable land. Areas of prohibited and limited use involving floodways and floodplains constitute 4,200 acres or 30 percent of the City's total land area.

In maximizing use of more developable land, building and pavement coverage has virtually depleted the original vegetation resources in the urbanized areas. Extensive agricultural use has substantially reduced the original vegetation resources in the more rural areas. As a result of land use intensification, only 3,800 acres or 7 percent of the 82 square mile Planning Area retain any significant vegetation resources. Preservation of these remaining vegetation resources is due largely to their association with stream corridors/drainageways.

These remaining resources are vital to the community. They provide habitat for wildlife, minimize stormwater run-off, stabilize soils, modify climactic effects, provide visual attractiveness and serve some recreational purposes. In recognizing their value, Ames has taken the first step to preserving these vegetation resources by identifying their location and evaluating their state of quality. Through the efforts of a committee of specialists the City has established a rating system to determine how sensitive a particular resource is to development.

Ames has also responded to the threat to its vegetation resources through an aggressive program of public acquisition and replanting. The City has acquired over 150 acres of woodlands for preservation purposes. Ames also has an extensive tree planting program for which it has received national recognition by the Tree City USA organization.

Suitability. Local experts, serving on the natural resource committee, mapped the known or suspected natural resources. Later they flew over these areas and visually verified their conclusions. Quality rating criteria were developed for these areas, and a botanist was retained to document the resources through field survey. The botanist then assigned quality ratings to these areas using the criteria developed by the committee. The following categories are the result of these efforts.

Highly Natural. This category comprises 138 acres or 1.0 percent of the City's total land area. The areas are small and locations are scattered. They can be found just north of Ontario Street near the railroad, along Clear Creek and in the northeast drainageway of Skunk River.

Due to their highly natural state, these areas are extremely susceptible to degradation and loss through any development or use, including recreational. In preserving these areas, protective buffers are required with regard to encroaching development and other less sensitive characteristics nearby.

Mostly Natural. This category comprises 1,061 acres or 7.5 percent of the City's total land area. It can be found throughout the Planning Area. Large pockets are located along Onion Creek, Clear Creek, Worle Creek, Squaw Creek and Skunk River. The largest pockets include the northeast drainageway of Skunk River, Innis Grove Park area and south of Squaw Creek.

These areas are more susceptible to degradation and loss through any development or use including recreational. Preservation of these areas is highly desirable.

Moderately Altered. This category comprises 900 acres or 6.4 percent of the City's total land area. Locations include Onion Creek, Clear Creek, College Creek, Worle Creek and Skunk River. There is also a large pocket along the steep slopes bordering Skunk River in the area just east of Inis Grove Park.

Limited development or use of these areas is possible without destroying their natural elements. Some recreational activities (biking, camping, etc.) may be compatible with maintaining the natural quality.

Highly Altered. This category comprises 873 acres or 6.2 percent of the City's total land area. These areas are found along Onion Creek, Clear Creek, College Creek, Worle Creek and Skunk River. The largest concentration is located along Onion Creek. This category is also found among the altered areas along the steep slopes of Skunk River in the portion east of Inis Grove Park.

Limited development or use of these areas is possible without destroying their natural elements. Some recreational activities (biking, camping, etc.) may be compatible with maintaining the natural quality.

Special Resources. This category comprises 551 acres or 3.9 percent of the City's total land area. These resources do not fit within the criteria of the previous categories. They include water resources, bike paths, the ISU arboretum, Isaac Walton League, the quarry north of Ames and others.

Permission Denied. This category comprises 282 acres or 2 percent of the City's total land area. These areas are suspected to be important natural resources, but permission to access these locations for verification was denied. These areas are limited to the northeast portion of the Skunk River, south of the periphery of the Planning Area and northwest of the City along Squaw Creek.

Growth Impact. Ames should make an immediate effort to conserve these remaining resources. The Clear Creek corridor is an example of where development is threatening these resources. Development cannot easily make use of the land that these resources occupy, but the fact that development is encroaching on the resources threatens their survival. A buffer is needed between development and the resources in order to fully protect them.

Natural Resource Recommendations. The corridors that these resources occupy should provide a connected and continuous greenway. These corridors benefit existing wildlife by protecting their habitat, and they also offer a means of linking the community with a linear park system that would benefit all residents. These corridors can provide safe pedestrianways and bikeways that can increase the cohesion of neighborhoods and the surrounding communities.

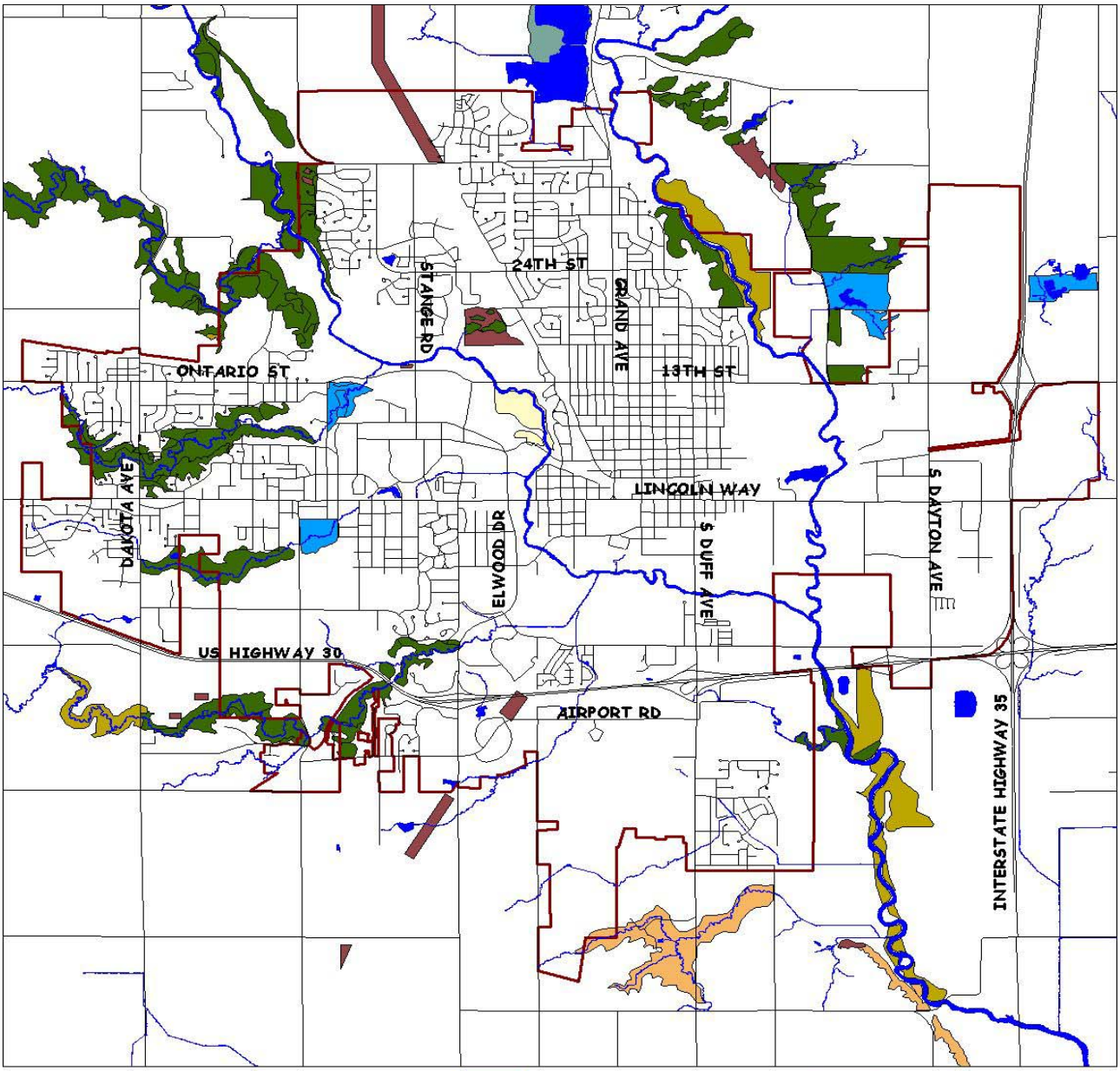
Water quality is also a concern for Ames. The Skunk River, the Squaw Creek, their tributaries and Hallets Quarry, are part of a complex system of watersheds that function to convey surface water through the area. All of these rivers and streams and the quarry north of the City are linked to the groundwater aquifer from which the City obtains its potable water supply. With the increase of urban and agricultural development, runoff increases, proportionately. As runoff increases, so does the level of pollutants. Existing resources provide a buffer to water resources. These buffers reduce runoff and filter out pollutants.

The Future Land Use Map identifies Environmentally Sensitive Areas that include selected natural resources and flood-prone areas to be protected.

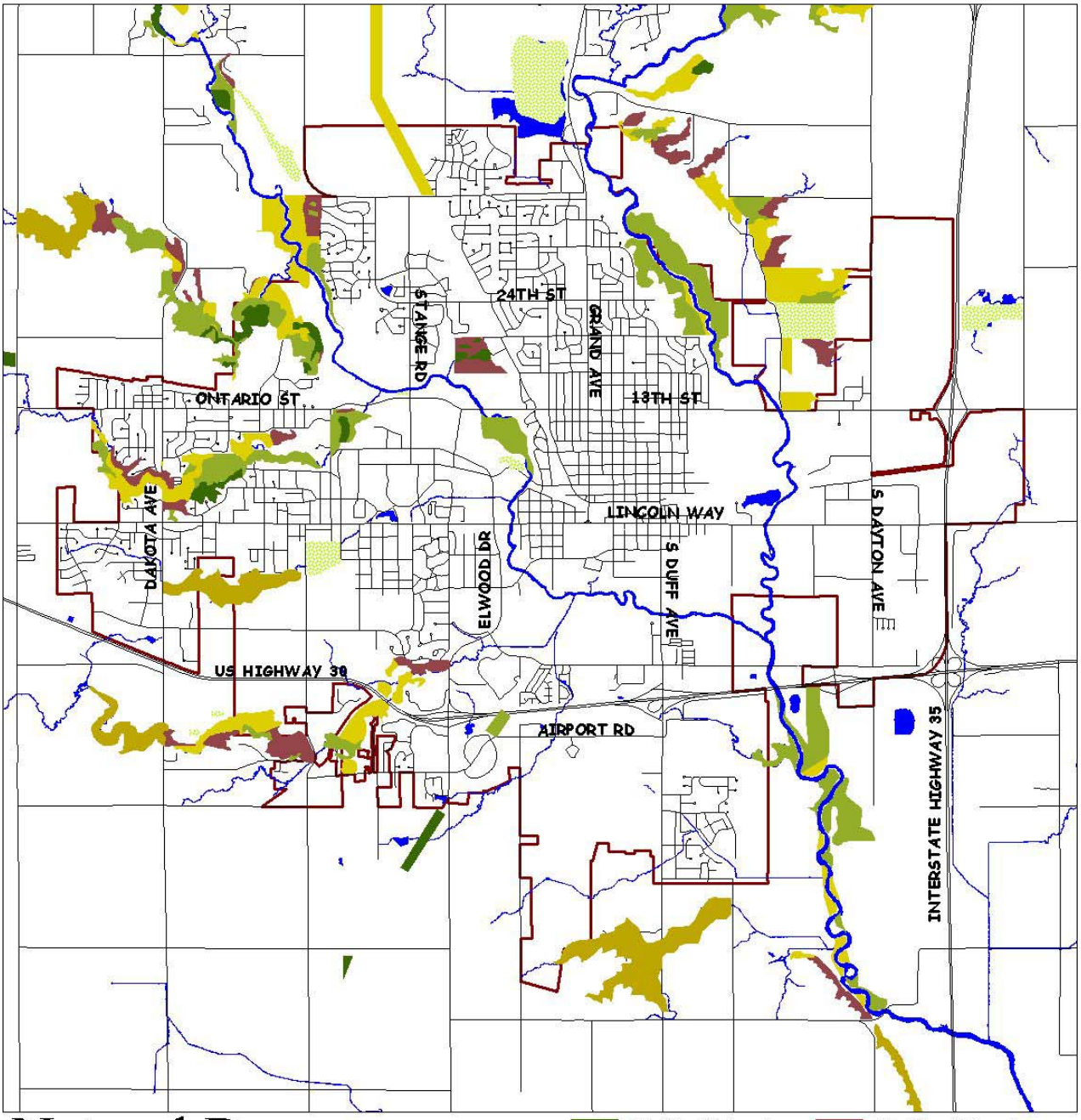
With respect to water resources, more detailed Stormwater Management Planning on a watershed level will likely be needed. To protect the water resources, mitigation measures such as stormwater quality ponds and other Best Management Practices will be required as development within a watershed occurs.

Where selected natural resources are included in Village Residential, they should be incorporated as part of the required open space. Where natural resources cannot be protected as part of open space requirements in new development, the City (or some private conservancy group) should seek their protection through acquisition, leasing or development transfer provision.

NATURAL RESOURCES INVENTORY MAP



NATURAL RESOURCES SUITABILITY MAP



Natural Resource Suitability Analysis

Highly Natural
Mostly Natural
Special Resource
Highly Altered
Altered
Moderately Altered

*1995 William Russel Norris, A Natural Area Inventory of Ames, Iowa

HYDROLOGY

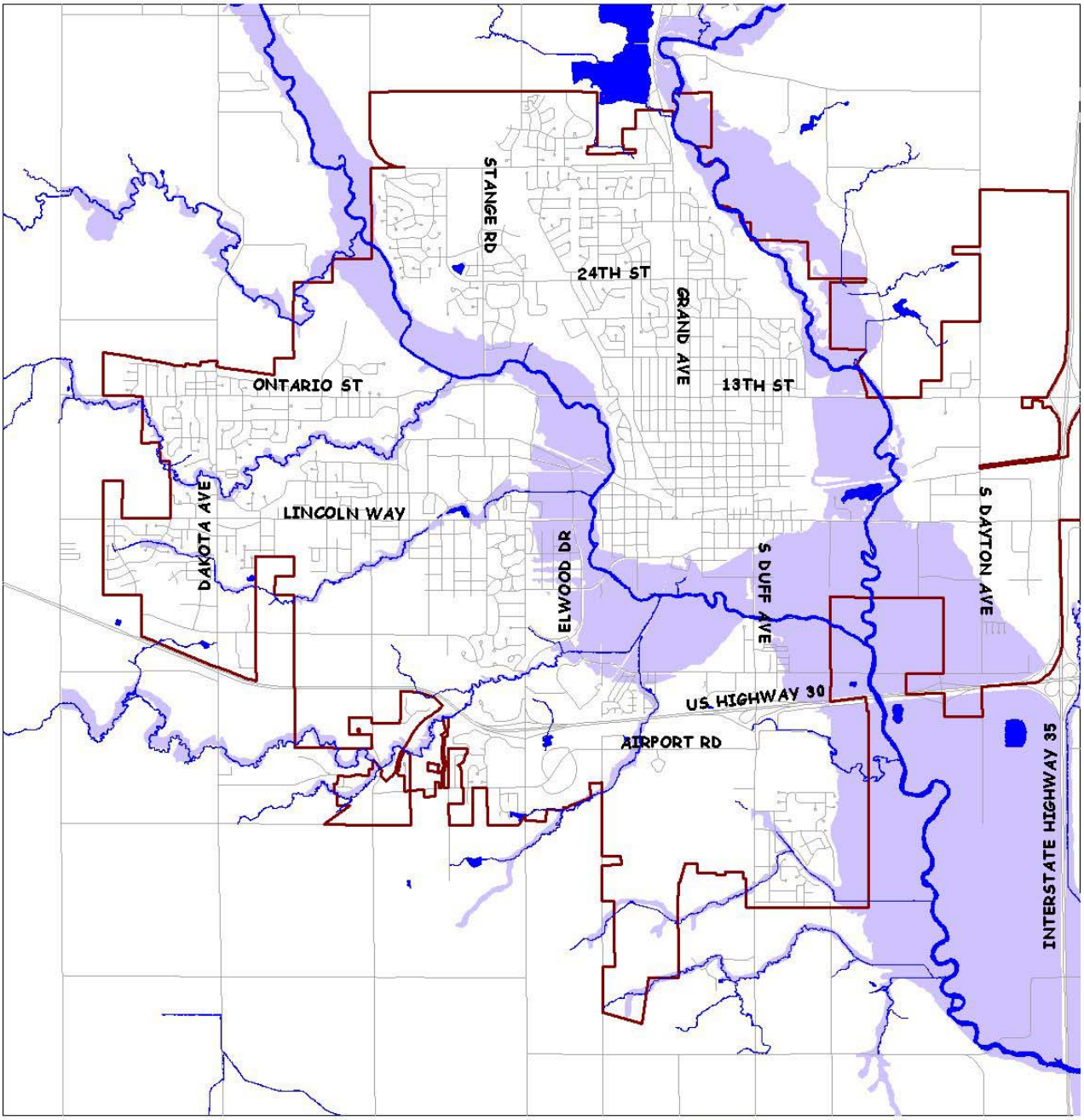
Watersheds. Due to the glacial deposit characteristics of the strata and the resulting modest topographic change, the city is divided into 6 major watersheds incorporating 35 sub-watersheds. The multiple watersheds create complex drainage systems that are associated with well-defined streamways.

These watersheds are connected by six drainageways. The largest is Skunk River, which traverses the entire Planning Area in a north-south direction. The smaller drainageways - Squaw Creek, Clear Circle, College Creek, Worley Creek and Onion Creek - interconnect and ultimately flow into the Skunk River. The drainageways are connected in such a way that they permit the gravity flow of the City's wastewater system that serves the 35 sub-watersheds. Their connectivity is conducive to a continued extension of the wastewater system that follows the drainageways and permits gravity flow.

Flood-Prone Areas. The flood of 1993 caused considerable damage to Ames. It is thought to have been a 500-year flood. The approximately 30 percent of the city's area that is indicated on the map as floodplain was entirely under water. The Iowa State University campus area was hit especially hard. Some of the single-family homes in the flooded area were purchased by the City. The vacant areas will remain as public open space.

The largest flood-prone areas are found along Squaw Creek south of Downtown and around the ISU-campus. Other large flood-prone areas are associated with the Skunk River. Development pressure has caused the in-filling and utilization by intense development in portions of the floodplain. The area of most recent impact is the commercial development associated with South Duff Avenue. Ames has more stringent in-filling standards than the State; however, the standards do not prevent development. Additional utilization will occur without the alternative of more suitable sites.

FLOOD-PRONE AREAS MAP



Flood-Prone Areas

*January 2, 1981 FEMA

Flood Fringe

SOILS

Method. Classification of the soils within the Ames Planning Area is based on Soil Capability Classes identified by the U.S. Soil Conservation Service. These classes identify a soil's suitability for agricultural and urban use based on the following factors:

- Composition;
- Damage risk when developed; and,
- Response to treatment.

The soils are further broken down into subclasses according to degree and kind of limitation. There are eight classes in the system ranging from Class I, which indicates few limitations, to Class VIII which indicates severe limitations, generally precluding development.

The subclasses are designated by adding a small letter e, w, or s to the class numeral. The letter "e" indicates that the main risk is erosion; "w" indicates that water is the main limitation; "s" indicates limitation due to shallowness, drought, or stones.

Inventory. The greatest percentage of land in the Planning Area is mostly made up of soils in Classes I, II and III. These classes are represented on the Soils Analysis Map as those soils that are the least restrictive to development. Almost all of this least restrictive area has been altered by urban or agricultural development.

Class I, II and III soils in Ames can be broken down into two major categories, poorly drained hydric soils and well drained erosion-prone soils. The first group, poorly drained hydric soils, includes capability units I, IIw, and IIIw. The second group, well drained erosion-prone soils, include capability units IIe, IIIe, IIIs.

The soils in the first group are contained within the Planning Areas' complex drainage systems. Due to the nearly level topography found in these areas and their geomorphic origins, they are poorly drained. These soils and the areas where they are found are unsuitable for sanitary facilities and prohibitive of some forms of development.

The soils in the second group are well drained and are moderately suited for sanitary facilities and development. The areas where soils in the second group are found offer the best conditions available for development in the Planning Area.

To date, Ames has developed largely in the areas categorized as least restrictive. To protect resources and minimize development costs, it is recommended that all future development be kept within areas categorized as least restrictive.

The areas represented on the Soils Analysis Map as moderately restrictive represent soils in classes IV-VII. These areas are more restrictive to development because of steep slopes and frequent flooding. The soils in these areas have not been developed due to these restrictions. They are closely associated with the major drainage system. Many of the community's natural resources are also found near the drainage system. Areas where natural resources and more restrictive soils are found together provide a basis for protection through restricting development. The soils found in these areas are also unstable and highly erodible. To protect them from

erosion, a dense ground cover needs to be maintained. The existing vegetation accomplishes this goal and to remove it could create undesirable conditions.

The urban land and other locations represented on the Soils Analysis Map are not assigned to a capability class and they are areas that have intense development or have been significantly altered. Downtown and much of the ISU campus falls within this category. These soils are typically developable if other site conditions allow. An on-site investigation is necessary to determine their full suitability.

Growth Impact. Approximately three-fifths of the undeveloped areas in the City are classified as having least restrictive soils. These areas are generally conducive to most types of development. The southwest growth priority area is largely suitable for the proposed residential uses. The northwest growth priority area is moderately suitable for the proposed residential use.

SOILS ANALYSIS MAP

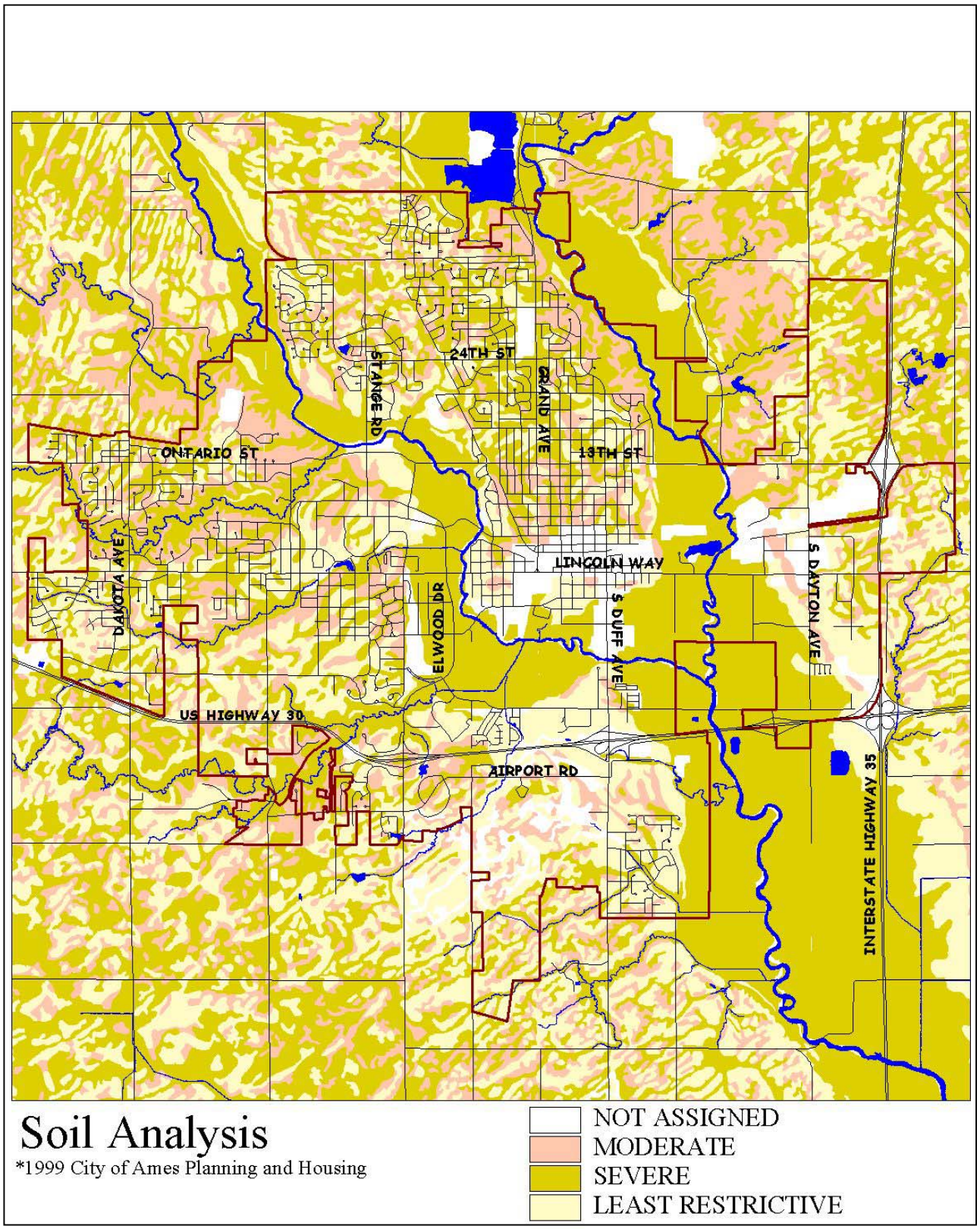


Table 7
SOILS CAPABILITY UNIT DESCRIPTIONS
City of Ames

CLASS I
Capability Unit I. Soils in this Capability Unit include (55) Nicollet Loam, 1 to 3 percent slopes; (203) Cylinder Loam, 0 to 2 percent slopes. These very gently sloping, somewhat poorly drained soils are found on slightly convex or plane slopes on knolls, outwash plains and swales.

CLASS II
Capability Unit IIe. Soils in this capability unit include (27B) Terril Loam 2 to 5 percent slopes; (108B) Wadena Loam 2 to 5 percent slopes; (138B) Clarion Loam 2 to 5 percent slopes; (236B) Lester Loam 2 to 5 percent slopes. These soils are gently sloping and well drained. They are typically found on terraces.

Capability Unit IIw. Soils in this capability unit include (54) Zooky Silt Clay 0 to 2 percent slopes, hydric; (95) Harps Loam 1 to 3 percent slopes, hydric; (107) Webster Clay Loam 0 to 2 percent slopes, hydric; (135) Coland Clay Loam 0 to 2 percent slopes, hydric; (386) Cordova Clay Loam 0 to 2 percent slopes, hydric; (485) Spillville Loam 0 to 2 percent slopes, hydric; (507) Canisteo Clay Loam 0 to 2 percent slopes, hydric; (559) Talcot Clay Loam 0 to 2 percent slopes, hydric. These soils are typically almost level, poorly drained and are found in slightly convex to slightly concave positions on uplands.

CLASS III
Capability Unit IIIe. Soils in this capability unit include (62C3) Storden Loam 5 to 9 percent slopes; (138C2) 5 to 9 percent slopes; (138D2) 9 to 14 percent slopes; (168C) Hayden Loam 5 to 9 percent slopes; (175B) Dickinson Fine Sandy Loam 2 to 5 percent slopes; (236C) Lester Loam 5 to 9 percent slopes; (236C2) Lester Loam 5 to 9 percent slopes; (236D) Lester Loam 9 to 14 percent slopes; (236D2) Lester Loam 9 to 14 percent slopes; (638C2) Clarion-Storden. Loam 5 to 9 percent slopes; (828B) Zenor Sandy Loam 2 to 5 percent slopes. These soils are moderately sloping and well drained. They can be found on knolls, uplands, and convex side slopes that border upland drainage ways. Slopes are typically short.
Capability Unit IIIw. Soils in this capability unit include (6) Okoboji Silty Clay Loam 0 to 1 percent slopes, hydric; (90) Okoboji Mucky Silt Loam 0 to 1 percent slopes, hydric. Soils within this capability class are poorly drained and are located in upland depressions. They are subject to ponding.

Capability Unit IIIs. Soils in this capability unit include (34C) Esthersville Sandy Loam 2 to 9 percent slopes; (175) Dickinson Fine Sandy Loam 0 to 2 percent slopes. These are nearly level to gently sloping somewhat excessively drained soils found on slight convex areas on stream terraces and uplands.

CLASS IV
Capability Unit IVe. Soils in this capability class include (62D3) Storden Loam 9 to 14 percent slopes; (62E) Storden Loam 14 to 18 percent slopes; (168E) Hayden Loam 9 to 18 percent slopes; (236E) Lester Loam 14 to 18 percent slopes. These soils are moderately steep, well-drained soils found on convex slopes that border streams and upland drainage ways. Slopes are generally short.

CLASS V
Capability Unit Vw. Soils in this capability class include (201B) Coland-Terril Complex 1 to 5 percent slopes, hydric; (1314) Hanlon- Spillville Complex 0 to 2 percent slopes; (1585) Spillville-Coland Complex 0 to 2 percent slopes. These soils are nearly level to moderately sloping poorly drained soils. They are found on floodplains, footslopes, and alluvial fans that receive run-off from adjacent uplands. They are subject to flooding.

CLASS VI
Capability Unit VIe. Soils in this capability class include (168F) Hayden Loam 18 to 25 percent slopes. These soils are steep and well drained. They are found on upland side slopes adjacent to major streams. Most areas are dissected by deep drainage ways.

Table 7
Continued

CLASS VII
Capability Unit VIIe. Soils in this capability class include (356G) Hayden-Storden Loam 25 to 50 percent slopes. These very steep well drained soils are found on upland side slopes adjacent to major streams. Most of these areas are dissected by many gullies and deep drainage ways. They constitute a severe erosion hazard.

CLASS VIII
(4000) Urban Land. This area is 75% or more covered by streets, parking, buildings, and other structures, obscuring the soil underneath making it unfeasible to identify. *(5010) Gravel Pits.* The majority of these
pits are inactive, but some are still being mined.

(5030) Quarry Pits. These pits are 10 to 50 feet deep or more. Piles of spoil one foot high to more than 30 feet high are in and surrounding the mined area. Sidewalls are nearly vertical. The pits with water are pumped dry during the quarrying process and often are allowed to be refilled with water when not in use or when vacated. On site investigation is necessary to determine safety.

(5040) Loamy Orthents. These are disturbed by man, but are still suitable for plant growth. It includes burrow areas, cut and fill areas, and reclaimed gravel pits.

(5050) Sandy Orthents. These unit consist of sanitary landfills at the eastern edge of the city of Ames. Much of the area has been filled, covered with sandy soil and leveled. In places topsoil has been placed over the surface.

WATER

Operations. The City of Ames owns and operates the water system that serves the population of approximately 48,000 within the incorporated area as of 1994. Additional City water supply is contracted to major non-residential users that are located immediately outside of the incorporated area. Other users outside of the incorporated area are served by several independent rural utility districts.

The City draws its raw water using up to 15 wells scattered within the incorporated area. One aquifer serves the entire City. It has proven to be a reliable source on a long-term and consistent basis.

Existing Facilities. Water from the wells is pumped to a centrally located treatment plant at Fifth Street near Crawford Avenue. The current capacity of this water treatment plant is 12 million gallons per day (mgd).

After treatment, the water is stored in three ground level tanks totaling 7.75 million gallons of capacity, plus two elevated tanks totaling 3 million gallons of capacity. Total storage capacity for the City is 10.75 million gallons or the equivalent of two days reserve based on the current usage of 5.6 million gallons per day.

Water Usage Trends. The City's water usage is evaluated based on average day and peak day. Between 1971 and 1993, average usage increased from 3.9 mgd to 5.6 mgd. For the same period, peak day usage increased from 6.1 mgd to 8.5 mgd. The change in average usage between 1971 and 1993 totaled 1.7 mgd. The change in peak day usage for the same period was 2.4 mgd.

Table 8
WATER USAGE TRENDS
City of Ames
1971-1993

(Million Gallons Per Day)

Year	Average	Peak Day
1971	3.86	6.14
1980	5.94	7.88
1986	5.84	7.34
1990	5.79	7.82
1993	5.58	8.42

Source: City of Ames, Engineering Dept. 1993

In recent years, residential usage has averaged approximately 53 percent of the total. In 1993, residential usage was estimated at 3.0 mgd and non-residential at 2.8 mgd.

Water Usage Projections. Based on current trends, average usage is projected to increase annually by 100,000-110,000 gallons while peak day use will increase annually by 200,000 gallons.

Table 9
WATER USAGE PROJECTIONS
City of Ames
1993-2030
(Million Gallons Per Day)

Year	Average	Peak Day
1993	5.6	8.5
2000	6.9	10
2010	8	12
2020	9	14
2030	10	16

Source: RM Plan Group, Nashville, 1994

By the year 2030, average usage is projected to increase to 10.0 mgd, almost double the current average of 5.6 mgd. By the year 2030, peak day usage is projected to increase to 16.0 mgd, almost double the current average of 8.5 mgd.

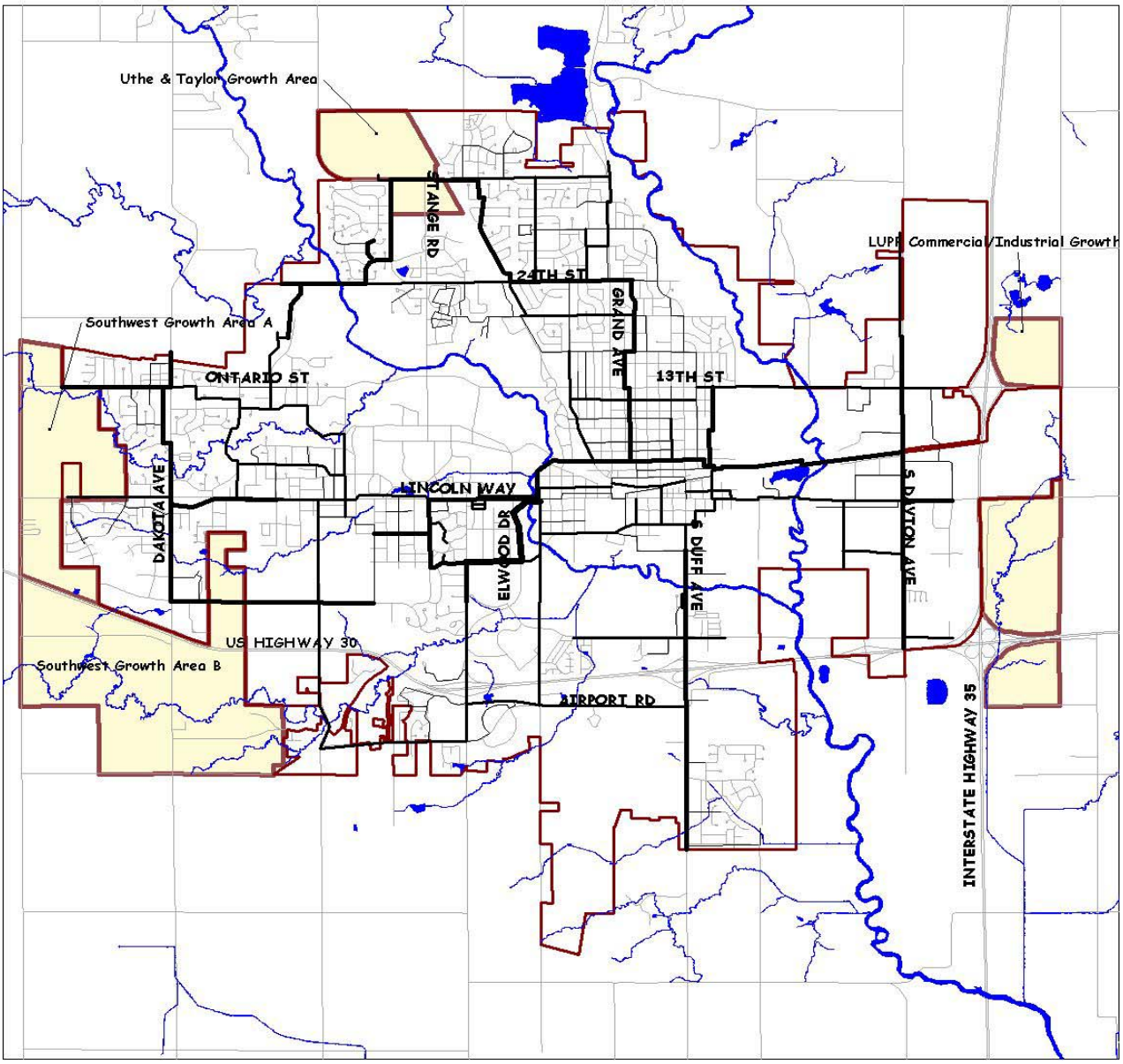
Comparison of Demand and Capacity. A comparison of projected usage/demand and current treatment of plant design indicates that capacity will reach 100 percent by the year 2010. Based on residential and non-residential projections for the year 2030, an additional capacity of 6.0 mgd is recommended.

Additional storage capacity is also required to meet projected growth by the year 2030. An additional 8 to 10 million gallons of storage capacity is recommended.

Growth Impact. The overall City is adequately served by the existing water system. Major areas of development are served by lines 12 inches or greater and most lines are looped to provide uninterrupted service and equalized pressure. Current concentrations of non-residential users are served by lines of 14 to 16 inches.

Growth impact is complicated by the presence of rural utility districts providing public water in areas beyond Ames. The frequent use of minimum size lines in addition to the discriminant distribution locations by these rural providers create dispersed and inefficient development patterns. There is also inadequate coordination between the rural districts and the urban system in Ames that must ultimately interface.

WATER SYSTEM MAP



Water System

*1997 City of Ames Public Works

Water Pipe Diameter

- 8 - 10
- 11 - 12
- 13 - 18
- 19 - 24

Proposed Expansion Areas

WASTEWATER

Operations. The City of Ames owns and operates the wastewater system that serves the population of approximately 48,000 within the incorporated area as of 1994. Additional treatment services are provided on a contractual basis with the City of Kelly, population 500. Other users outside the incorporated area are served by individual systems.

Existing Facilities. In 1989, the City opened a new wastewater treatment plant on the South Skunk River. The plant has a design capacity of 12.1 million gallons per day (mgd). Current usage is averaging 6.5 mgd or approximately half of capacity. Discharges from the wastewater treatment plant are within acceptable limits currently. Current biological oxygen demand (bod) counts are 16,150 pounds per day or approximately 60 percent of the 26,990 pounds permitted by federal standards for South Skunk River. Current solids emission is 2 parts per million compared to 20 parts per million permitted by federal standards.

The existing collection system is generally adequate in terms of size and condition. A major rehabilitation of lines has been completed in removing most inflow and infiltration problems. Inflow problems related to sump pumps/house drains are currently being resolved. ISU also has inflow problems, which are currently being corrected.

Some surcharging of lines is present. The areas with the greatest problems involve Burnett, Clark, Wilson, Grand and Murray. A second area is Lincoln Way near the University. Scattered small problem areas are found further west and north.

Table 10
WASTEWATER FLOW TRENDS
City of Ames
1991-1992
(Million Gallons Per Day)

	1991		1992	
Month	**Avg.**	**Max.**	**Avg.**	**Max.**
January	4.625	5.19	5.377	6.111
February	5.387	5.85	6.172	7.635
March	7.414	10.304	7.184	9.6009
April	11.572	22.888	8.006	12.32
May	10.652	24.341	8.287	8.596
June	9.997	28.572	4.799	5.233
July	5.388	6.516	5.865	11.004
August	5.062	5.666	6.491	10.129
September	5.36	6.238	5.616	6.046
October	5.378	6.608	5.122	5.454
November	5.692	7.817	5.349	6.558
December	5.377	6.11	5.739	8.002

Source: City of Ames, Water Pollution Control Plant, 1994.

Wastewater Flow Trends. The City's wastewater treatment is evaluated based on average and maximum flow. During the 1991, the annual average flow was 6.8 mgd while maximum flow briefly exceeded the 12.1 mgd design capacity during the three rainiest months. During the year 1992, the annual average flow was 6.2 mgd while maximum flow was at or below the plant's design capacity for every month. Flows for the year 1993 were discounted due to the excessive and prolonged flooding which caused unusually high flows.

Wastewater Flow Projections. Based on current trends, average flow is projected to increase annually by 100,000 gallons. By the year 2030, average flow is projected to increase to 10.0 mgd, or about half again the current flow.

Table 11
WASTEWATER FLOW PROJECTIONS
City of Ames
1992-2030
(Million Gallons Per Day)

Year	Average	Maximum
1992	6.2	8.5
2000	7	10.5
2010	8	12
2020	9	13.5
2030	10	15

Source: RM Plan Group, Nashville, 1994

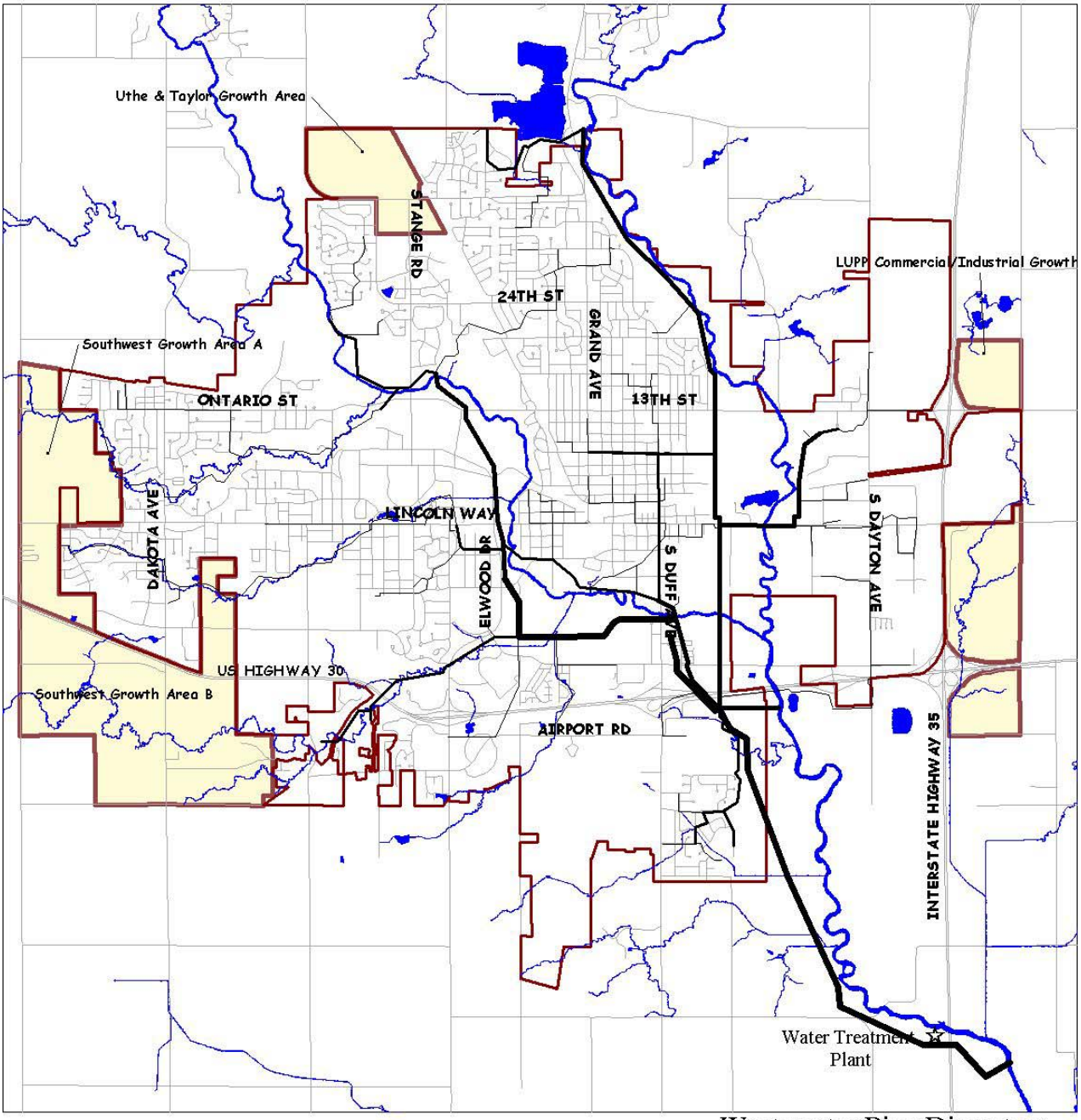
Comparison of Demand and Capacity. Based on maximum flow projections, the design capacity of 12.1 mgd should be reached around the year 2010. The plant was designed so that a second treatment train can be readily added in doubling the capacity to 24.2 mgd. Additional land at the treatment plant is available for further expansion.

Growth Impact. All development portions of the City are adequately served by the existing wastewater collection system. The proposed southwest growth priority area is currently unserved by the public wastewater system. Nearby trunk lines have adequate capacity to carry the additional development. Extension of service can be provided cost-efficiently.

The proposed northwest growth priority area is also currently unserved by the public wastewater system. Nearby trunk lines have adequate capacity to carry the additional development. Extension of service may be affected by the presence of environmentally sensitive areas and by more topographic change.

Development of the eastern side of I-35 will require major extension of service. The interstate highway presents a barrier to expansion and installation under the interstate highway will be costly.

WASTEWATER SYSTEM MAP



Wastewater System

*1996 City of Ames Public Works

Wastewater Pipe Diameters

- 8 - 20
- 21 - 35
- 36 - 42
- 43 - 66

Proposed Expansion Areas

STORMWATER

Operations. The City of Ames provides a publically maintained system for the collection and disposal of stormwater run-off throughout the incorporated areas. Within the older and more intensely developed urban core an underground piped system is provided. An additional open channel system is provided in the newer residential suburbs.

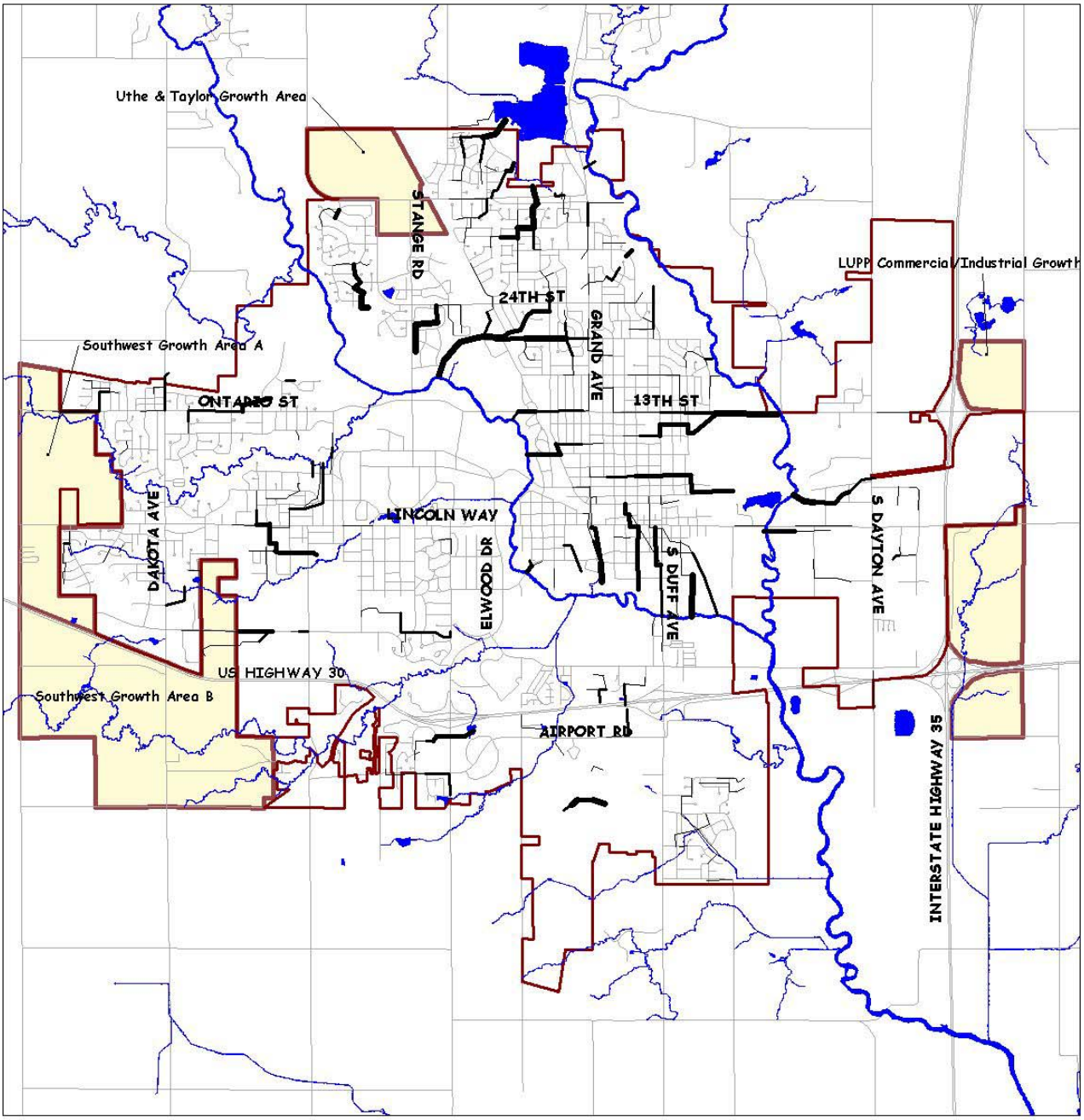
Existing System. The existing system within the urban core was built to earlier design standards that were more specific to limited areas. Over the years the increased intensification of development in the urban core has exceeded the capacity of the system.

Within recent years the City has developed an overall management system. Current design standards are based on a five-year flood. Individual site improvements are required that involve detention until the peak run-off has occurred and then allow entry into the public collection system. Construction of on-site improvements is the responsibility of the individual property owner while maintenance is provided by the City. Constraints are occurring in the newer system due to the difficulties and expense of the City maintaining the system.

Growth Impact. Further intensification of the urban core is limited by the existing stormwater system. Overall improvement is required along with the possibility of more underground detention facilities for individual sites.

Within the undeveloped areas, some discussion is emerging on the provision of large public detention areas in-lieu of most or all on-site detention. Under this type of management system stormwater run-off would be taken immediately off the site and into the public system where it would be detained in a series of large flood-proof holding areas for managed disposal. The hydrological characteristics of the Planning Area would appear to support such a management system.

STORMWATER SYSTEM MAP



Stormwater System

*1998 City of Ames Public Works

Stormwater Pipe Diameters (inches)

- 21 - 30
- 30 - 40
- 41 - 49
- 50 - 72
- Proposed Expansion Areas