

COUNCIL ACTION FORM

SUBJECT: NORTHWEST GROWTH PRIORITY AREA SANITARY SEWER STUDY

BACKGROUND:

City Council was approached over two years ago by developers with an annexation request for the Fieldstone development on 442 acres of land in the Northwest Priority Area. Since that time, the City council has considered two reports comparing costs for growth to the Southwest, Northwest, and North. On July 15, 2008, the City Council retained its plan to support growth in the Southwest and Northwest priority areas.

On August 28, 2008, City Council directed staff to develop a design concept for a sanitary sewer through the Northwest Growth area by working with interested property owners in an attempt to minimize negative impacts and disruption to the area, gathering information about environmental concerns, and exploring streambed stabilization techniques in this area. This would allow City Council and the developers to have a clear understanding of the environmental impacts and the estimated costs of the sewer for an annexation agreement.

On January 27, 2009, City Council approved an engineering agreement with Stanley Consultants to conduct the sanitary sewer study. As part of the study, Stanley and their sub-consultants performed an environmental inventory to identify botanical assemblages, zoological habitat and wetland areas, and to assess stream bank, stream channel, and cultural resource conditions in the potential sanitary sewer corridor. A Citizen's Advisory Committee was also formed and held four meetings over a six-month period.

During this process two alternatives for serving the Northwest Growth Priority Area were evaluated. They included an alternative for service to the area by a gravity sewer system in the Onion Creek corridor (Figure ES-1, Executive Summary). This alternative is a traditional method to take advantage of the natural slope of the creek corridor to provide sanitary service. The second alternative involved service to the area by a combination of lift stations and gravity mains (Figure ES-2, Executive Summary). The addition of the lift stations and associated force (pressure) mains would allow the sewer to avoid any sensitive natural areas while still serving the Northwest Growth Priority Area.

Based on the study's environmental reviews and committee feedback, it is recommended that the City support the lift station alternative as a conceptual plan for sewer construction as development occurs in the Northwest Growth Priority Area. The full build-out cost of this system is estimated to be \$3.7 million for primary trunk sewers and pump stations. The total estimated developable land

area is 1,178 acres. The total cost divided by this area amounts to \$3,100 per acre. The gravity sewer alternative within the Onion Creek corridor has an estimated cost of \$4.3 million. However, the on-going operational costs related to this alternative are less than the lift station option. This alternative would also serve a developable area of 1,178 acres.

The Committee also wanted the City to consider that with future development there would be an opportunity to protect the environmental resources and would want the City to consider options in that regard (i.e. special zoning classification or a required buffer to protect and enhance these resources). The environmental experts recommend a 100-foot to 200-foot buffer to protect and enhance the sensitive areas. This buffer area could also be used for stormwater management and could accommodate a shared use path. For every 100-foot of buffer that is required, the developable acres would decrease by approximately 100 acres for the Northwest Growth Priority Area. This would cause an increase in the developable cost per acre for sanitary sewer service.

ALTERNATIVES:

1. Accept the Northwest Growth Priority Area Sanitary Sewer Study and the Citizens Advisory Committee's recommendation that at the time of development the Northwest Growth Priority Area be served by a combination of lift stations and gravity sewers to minimize the impact on environmental resources.
2. Accept the Northwest Growth Priority Area Sanitary Sewer Study and choose the alternative option of gravity sewer to serve the area.
3. Reject the recommendation and delay decisions on sanitary sewer service to the Northwest Growth area.

MANAGER'S RECOMMENDED ACTION:

After reviewing the information presented by environmental experts and the City of Ames, the Citizens Advisory Committee recommended serving the Northwest Growth Priority Area in a way that minimizes the impacts on the environmental resources that were identified through the sewer study process.

Therefore, it is the recommendation of the City Manager that the City Council approve Alternative No. 1, thereby accepting the Northwest Growth Priority Area Sanitary Sewer Study and the Citizens Advisory Committee's recommendation that, at the time of development, the Northwest Growth Priority Area be served by a combination of lift stations and gravity sewers to minimize the impact on environmental resources.

It should be understood that while this option reflects the lowest upfront capital costs and the highest level of local environmental protection, it does require higher on-going operational costs (e.g., electric consumption) than relying solely on a gravity sewer.

Northwest Growth Priority Area Sanitary Sewer Concept Study

Executive Summary



City of Ames
Ames, Iowa

October 2009



Stanley Consultants INC.

A Stanley Group Company
Engineering, Environmental and Construction Services - Worldwide

Northwest Growth Priority Area Sanitary Sewer Concept Study

Executive Summary

City of Ames
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I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Iowa.


Jonathan D. Garton, P.E.

10/22/2009
10/22/2009

My license renewal date is December 31, 2010.

Pages or sheets covered by this seal: All



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Executive Summary

Background

On August 26, 2008, the Ames City Council passed Resolution No. 08-384 directing staff to develop a sanitary sewer design concept for the Northwest Growth Priority Area (NWGPA). This was to be accomplished by working with interested property owners in an attempt to minimize negative impacts and disruption to the area, to gather information about environmental concerns, and to explore streambed stabilization techniques. City Council and the developers would then have an approved sewer routing concept and a clear understanding of estimated costs of the sewer for an annexation agreement.

To meet the City Council needs, the City contracted with Stanley Consultants to complete a study to inventory the natural and cultural resources of the area and to evaluate construction alternatives and routes that minimize or avoid environmental impacts. This study included an environmental inventory of the creek corridor, assessment of streambed and bank condition, evaluation of alternative sewer routes and technologies, conducting a public meeting with local citizens and landowners asking for their input on the development of an acceptable plan for sewer service for the area, and facilitating four Citizens Advisory Committee meetings to provide direction throughout the study.

Study Process

Using the Worle Creek Sanitary Sewer Extension Study completed by Stanley Consultants in 2005 as a successful model, a major component of the NWGPA study included detailed study of the floral and faunal characteristics of the Onion Creek corridor and a small section of the Squaw Creek corridor to assess the biological quality of the study area. To accomplish this assessment, experts from Drake University's Department of Environmental Science and Policy were contracted by Stanley Consultants as subconsultants to conduct a detailed botanical and zoological inventory. A Stanley Consultants' wetland specialist evaluated the stream corridor for potential wetlands. A stream morphology specialist from Iowa State University was contracted to

perform the assessment of the streambed and bank condition. In addition, the cultural resources of the area were investigated by another subconsultant, the University of Iowa's Office of the State Archaeologist. By bringing these specialists onto the study team, an evaluation of character and quality of the environment along the Onion Creek and Squaw Creek corridors was evaluated based on good credible science.

Public input throughout the duration of the study was a key component to gain acceptance of a workable plan for providing sewer service to the NWGPA. Coordination with local citizens and landowners was accomplished with a public involvement program to engage those residents impacted by the project as partners in assessing alternatives, techniques and solutions that would allow the project to go forward once development is ready to take place. This program included a public information meeting that explained the purpose and goals of the study with a call for volunteers to serve on a Citizens Advisory Committee. The Citizens Advisory Committee was comprised of citizens who represent the views of the larger group of citizenry that have an interest in this study and are motivated to participate in a series of workshops to evaluate alternatives for sewer service to the NWGPA. Following the public meeting, the Citizens Advisory Committee was formed with nine active members that met four times over a 6-month period.

Stanley Consultants developed two preliminary sanitary sewer routing concepts. These concepts were based on existing topography, development area, environmental reviews, and citizen feedback. They are conceptual in nature and only preliminary engineering has been performed to determine general slopes, depths, and pipe sizes.

Environmental Reviews

Faunal Review (by Dr. Keith Summerville, Drake University)

The overarching goal of this study was to provide a critical assessment of the current faunal diversity as it relates to the design concepts for proposed sewer construction through the Onion Creek corridor in the project area. This report contains four principle areas of focus: (1) a literature review for sources of data that specifically characterize the faunal diversity of the Onion Creek study area, (2) a report on the results of an inventory of mammals, herps, birds, and butterflies within the Onion Creek corridor, (3) a critical evaluation of the corridor as habitat for species listed as threatened or endangered under federal or state statutes, and (4) a set of recommendations for mitigation and design of a hypothetical sewer route along the Onion Creek corridor.

The results of the study suggest that the entire Onion Creek area functions as a *moderate to high quality greenbelt*; it provides habitat for a diversity of animal species, some of which appear to be declining in abundance across their ranges but none of which are threatened or endangered in Iowa. Recommendations for sewer design are: to ascertain if bald eagles use wooded portions of Onion Creek for nesting (unlikely) or winter roosting; to pursue additional and more intensive field surveys of the area for bull and smooth green snakes; to conduct a more temporally extensive butterfly survey, emphasizing species groups that fly in spring (duskywing skippers) and mid to late summer (e.g., hairstreaks); to visit vernal pools and remnant oxbows within the corridor in the early spring to document breeding populations of salamanders; and, at a minimum, to pursue sewer engineering options that significantly

reduce fragmentation of existing woodland habitat in the Onion Creek area. Reducing habitat fragmentation can be accomplished in a number of ways such as routing the sewer line around existing woodland edges, reducing the width of vegetation cleared during construction and minimizing the length of the sewer line that bisects woodland habitat. To the extent feasible, alternatives to sewer construction through the Onion Creek corridor need to be seriously considered, as construction of the sewer line will, at least temporarily, disrupt faunal use of the woodland habitat.

Floral Review (by Dr. Thomas Rosburg, Drake University)

There are approximately 900 native plant species that have a range that includes central Iowa (a 12 county area in the center of the state). Story County, where the Onion Creek study area is located, is in the center of this geographic region. Over 29 percent of them, or about 262 native species, were observed in the Onion Creek study area, which focused on the stream corridor (the landscape in and adjacent to the stream valley). A review of the Iowa Department of Natural Resources natural areas inventory database found 14 state-listed species (endangered, threatened, or special concern) that have been documented with a voucher in western Story County and eastern Boone County since 1989. Another 14 state-listed species have been documented since 1879. These 28 species comprise a little over a third of the state-listed species that range into central Iowa. Although no listed species were observed during this study, two non-listed species that are currently tracked in the natural areas inventory database by the Iowa DNR were observed.

The predominate plant communities in the Onion Creek corridor study area include a variety of upland forest (e.g., oak, mixed species) that range from late to early successional. Likewise, lowland forest and woodland communities occur extensively that range from late to very early successional. Other less prominent communities include cool-season exotic grassland, cool-season savanna, early successional wetland, a hill slope seep, early successional conifer woodland and tall forb meadow. There is considerable range in the quality of these plant communities, which is mostly related to its successional status and exotic species component. Generally the later successional forests, both upland and lowland, exhibit a greater quality with regard to plant species composition (e.g., conservative species) and ecosystem structure (development of stratification). The late successional forests are also characterized by larger, older trees. Many large specimens of bur oak, white oak, red oak, black maple, and basswood were observed in the upland forests. Many of the bur oak were remnant savanna, or "wolf" trees. In the lowlands, large specimens of bur oak, green ash, honey locust, and cottonwood were observed.

Over 30 plant species were observed that currently have a coefficient of conservatism greater or equal to 7 (0 to 10 scale). Conservatism is used to describe species that tend to be associated with more pristine ecosystems, that is they do not tolerate human disturbance very well. In this study, nearly all of these species were forest species which were observed in the higher quality forest tracts. These relatively higher quality communities occur on both the upstream (west of North Dakota Avenue) and downstream segments of Onion Creek. The overall floristic assessment then, is that although there are low quality habitats within the corridor (these being early successional forests, with dense shrub and sapling layers of primarily exotic species and exotic grasslands), there is a significant amount of high quality

forest environment present that clearly contributes to the impressive natural and wild character that the valley exhibits. Such landscapes, especially with a relatively undisturbed stream, are uncommon in Iowa. The results of this study show that most of this section of Onion Creek provides essential protection of Iowa's natural heritage, which will be compromised by construction of a sewer line in the valley.

Wetland Review (by Ed Slattery, Stanley Consultants)

Stanley Consultants performed a stream corridor investigation within the boundaries of the NWGPA along Onion Creek from County Line Road (500th Avenue) to its confluence with Squaw Creek and along a portion of Squaw Creek from Veenker Memorial Golf Course north approximately one mile. The purpose of the field reconnaissance was to verify wetland information presented on the U.S. Fish and Wildlife Service's National Wetland Inventory (NWI) map and determine the likelihood of additional wetlands in the corridor to assess possible impacts from future sewer construction. The goal of the field effort was to assess the potential for wetlands – not to perform wetland delineations. Moreover, only the creek valley was field checked. It is assumed that any wetlands located in upland areas could be more easily avoided by a shift in the sewer alignment than if the sewer alignment were to occur within the stream corridor.

The NWI map shows the presence of only a few scattered wetlands within the NWGPA. Based on field observations, the NWI map presents a reasonably accurate assessment of the presence of wetlands in the stream corridors. Only scattered wetlands may be present with nearly all of the potential wetlands located within meander scars or along inside bends on Squaw Creek. Several meander scars were found that will require more detailed investigation to determine if they are wetlands should a sewer route within or near the area be selected.

Much of the low terrace area along both sides of Onion Creek and Squaw Creek are heavily forested with upland tree species and light sandy and/or silty soils. Wetland communities normally cannot be supported on this type of soil. Field observations confirm that upland species generally occupy the low terrace areas. However, the presence of isolated linear depressions (meander scars) occur where wetland vegetation, hydrology and soils were observed. These linear depressions can be up to 300 feet long, 35 to 45 feet wide and 3 to 5 feet below the surrounding landscape.

As a result of these field investigations, it does not appear that there are sufficient wetland areas to warrant considering alternate routes on the basis of wetlands alone. The sequencing process would need to be applied in refining the sewer route along the corridor which includes avoiding existing wetlands, minimizing wetland impacts when they cannot be avoided or mitigation for wetland impacts when there are sufficient wetland functions lost that new compensatory wetlands must be created at an approved on-site or off-site location.

Archeological Review (by Cynthia L. Peterson, Office of the State Archeologist)

A Phase IA archaeological reconnaissance investigation was conducted by the University of Iowa Office of the State Archaeologist for the NWGPA. The project area encompasses 676 ha (1,670 acres). Erosion control pond construction has disturbed 2 ha (5 acres) of the project area. Steeply sloped areas with low potential to contain cultural materials encompass another

39 ha (97 acres). Previous professional archaeological survey has covered 70 ha (173 acres). Eight previously recorded archaeological sites are mapped within the project area. Four of these have been previously subjected to Phase I survey, with two sites also the focus of Phase II testing and Phase III data recovery. Prior archaeological investigations resulted in a recommendation of no further work at all four sites. Three sites are ephemeral prehistoric sites which were previously recommended for no further work. One site is a prehistoric open habitation site; no archaeological recommendations have previously been made with regards to this site. Several structures (farmsteads, rural residences, and rural schools) are depicted in the project area on historic maps and aerial photographs but have no extant structures today; traces of these structures may still exist as archaeological sites.

Given that the potential for surficial and buried archaeological sites exists and that much of the project area appears generally undisturbed by previous construction or other landscape-altering activities, Phase I archaeological investigation is recommended prior to any ground disturbing activities within 83.5 percent of the project area, specifically, at the 565 ha (1,395 acres), which is not steeply sloped, previously disturbed, or previously surveyed.

Streambank Assessment (by Mimi Wagner, Iowa State University)

Onion Creek provides the best example of a fairly undeveloped stream with high habitat value in the Ames area. This condition is likely due to the lack of urban development and low number of agricultural drainage tiles impacting the stream. Construction (such as traditional sewer line installation) across the stream channel will likely negatively impact the stable structure and habitat condition of the stream.

Six elements were included in this research: stream channel stability, streambank erosion, stream channel nick points, low head dams, culvert discharge points, and stream biological assessment data. Stream channel stability and erosion data from 2009 was compared to data collected in 2006 for Onion Creek and 2003 for Squaw Creek.

Squaw Creek 2009 conditions were very similar to 2003 assessed conditions for the same segment. While soil loss estimates and channel evolution studies both indicated degradation since 2006, Onion Creek remains a fairly stable channel with excellent habitat structure. According to Iowa DNR data, Onion Creek provides the highest in-stream habitat of any Squaw Creek tributary in the area.

Fifty-eight percent (13,996 LF) of the Onion Creek channel was characterized as fairly stable, with channel widening complete or nearly complete. The remaining 42 percent (10,150 LF) of the channel was actively either downcutting or widening. Total soil loss estimates for the Onion Creek study reach equaled 1,595 tons per year; 2006 soil loss estimates for the same reach totaled 656 tons per year. Increased erosion rates since 2006 were attributed to either upstream migration of unstable points identified in 2006 (because mitigation did not occur), continued degradation of reaches mapped as unstable in 2006, and new segments of instability that did not exist in 2006.

Any near-stream construction could negatively impact stream stability. Furthermore, a minimum amount of immediate restoration is recommended regardless of the pending land

development and sanitary sewer construction progress. These restoration actions will slow future degradation of Onion Creek and allow people to continue to benefit from its high value and function.

Alternative Sewer Concepts

Based upon the service area extents and loading assumptions as well as available slope for the sewer, preliminary sewer routings for each concept were determined. A No Action option was included for comparison purposes. Each concept is described in more detail below.

Each sewer concept must connect to the existing 27" trunk sewer that is located on the east side of Squaw Creek. This trunk sewer was sized to accommodate the future development along Onion Creek.

- Concept 1 is the No Action option. While this option does not cause any environmental disturbance, it also does not bring sanitary sewer service to the NWGPA and does not satisfy the requirements of the land use plan or meet the charge of the City Council for the work of the Citizens Advisory Committee.
- Concept 2 utilizes a gravity sewer trunk along the Onion Creek corridor. It represents the common historic method for sewer layout where the primary trunk sewer is installed along a creek in order to take advantage of the natural slope of the creek corridor and allow connections from all the surrounding service areas without the need for pumping. As the primary trunk sewer would need to be installed in the lower portion of the valley near the creek, a corridor of approximately 50 feet would have to be cleared through the existing woodland areas. A cleared path of approximately 20' wide would need to be maintained long-term for future access for maintenance and repair of the sewer. Where the sewer crosses the stream, it would be installed by boring or jacking the pipe across the creek instead of cutting an open trench through the creek. The required trunk sewer sizes range from 8" in the upstream portion to 24" at the connection with the existing sewer. Figure ES-1 shows the Concept 2 sewer route. The total cost of all sewer infrastructure for Concept 2 is \$4.3 million.
- Concept 3 has been developed to avoid as many of the natural woodland areas as possible. In order to accomplish this, sewage lift stations are required to pump the flow up and around the sensitive areas. This concept is shown on Figure ES-2. As many as four lift stations would be required for full development of the growth area. The largest of which would be located near North Dakota Avenue and would serve Areas A, B, and G. The total cost of all sewer infrastructure for Concept 3 is \$3.7 million.

Each concept has pros and cons and these have been summarized in Table ES-1. In general, Concept 2 provides the long term benefit to the City of not requiring energy use or maintenance of mechanical systems, but results in the highest impact to the existing woodland areas. Concept 3 requires the ongoing maintenance and energy consumption for the pump stations but preserves the high quality woodland and prevents fragmentation and degradation of existing habitats.

Table ES-1 Routing Concept Pros and Cons

Sewer Route Concept	Pros	Cons
1 No Action	<ul style="list-style-type: none"> • No creek disturbance. • No cost to City. • No environmental impact. 	<ul style="list-style-type: none"> • Development cannot proceed without a trunk sewer line, as septic systems are not allowed in the City. • Does not satisfy the City's Directive.
2 Gravity Sewer in Creek Corridor	<ul style="list-style-type: none"> • All areas in service area can drain by gravity into sewer, thus requiring no pump stations. 	<ul style="list-style-type: none"> • High environmental impact. • Difficult construction access. • Many creek crossings required. • Cannot stage construction. • Higher construction cost than Concept 3.
3 Gravity sewer where possible without disturbing woodlands; three lift stations to service all developable areas	<ul style="list-style-type: none"> • Minimal creek disturbance - lower environmental impact. • Serves large portion of developable area with gravity sewer. • Can stage a portion of construction. • Least amount of installed trunk sewer. • Lower construction cost than Concept 2. 	<ul style="list-style-type: none"> • Pump stations increase operation and maintenance costs. • Lower expected life span of infrastructure (pump stations) compared to an all gravity pipe sewer system.

Source: Stanley Consultants, Inc.

Concept Selection

The environmental experts agreed that sewer construction along the creek channel that results in fragmentation of the wooded areas would result in a detrimental impact to the quality of the habitat.

After hearing presentations from the university biology experts discussing the quality of the woodland habitat, the Citizens Advisory Committee concluded that the best solution would be to avoid these areas by utilizing Concept 3 as shown on Figure ES-2. This concept uses three lift stations to avoid disturbance of the woodland areas. The Committee was concerned about the impacts of construction of the sewer and development as a whole on the existing woodland corridor. They recommended the City recognize the sensitive nature of the woodland corridor while reviewing proposed development plans.

Recommendations

Based on the environmental reviews and committee feedback, it is recommended the City proceed with Concept 3 as a conceptual plan for sewer construction as development occurs in the Northwest Growth Priority Area. The full build-out cost of this system is estimated to be \$3.7 million for primary trunk sewers and pump stations. The total estimated developable land area is 1,178 acres. This includes potential conservation buffer areas that if established would decrease the total amount of land that could be developed. The total cost divided by this area amounts to

\$3100 per acre. The per acre cost of developable land would increase if significant buffer areas are established.

As requested by City staff, Table E-2 shows the costs of sewer infrastructure broken down to a "baseline" cost and oversizing costs. The Capital Improvement Strategy as outlined in the City's Land Use Policy Plan provides for the City to pay for oversizing costs in suburban residential development when the City's capacity needs exceed the needs of the development. These values are useful for determining split funding negotiations between developers and the City.

Table ES-2 Sewer Cost Breakdown for Funding Alternatives

Service Area	Base Cost ⁽¹⁾	Development Oversize Cost ⁽²⁾	Oversize Cost ⁽³⁾	Total Cost
A	\$1,096,639	\$45,640	\$914,669	\$2,056,948
B	\$472,102	--	--	\$472,102
C	--	\$77,787	--	\$77,787
D	\$328,784	--	--	\$328,784
E&F	\$498,825	--	--	\$498,825
G	\$216,675	--	--	\$216,675

(1) Includes costs for 8" gravity sewer, 4" force main and 0.1 MGD pump station.

(2) Includes gravity sewers inside service areas required to be upsized to serve the entire service area.

(3) The difference between the costs to build the recommended sewer system and the base costs.

Source: Stanley Consultants

Table ES-3 shows the costs of the required sewer infrastructure have been divided into phases based on the amount of infrastructure required to serve each development area in order as shown on Figure ES-2. Phase 1 includes all infrastructure and sewer upsizing required to serve Area A. Phase 2 includes the additional infrastructure required to serve Area B, and so on.

Table ES-3 Sewer Infrastructure Costs by Phase

Phase	Service Area	Acres	Total Cost	Potential Connection Fees	Balance
1	A	489	\$2,056,948	\$1,515,618	(\$541,330)
2	B	70	\$472,102	\$216,960	(\$796,472)
3	C	326	\$77,787	\$1,010,412	\$136,153
4	D	82	\$328,784	\$254,153	\$61,522
5	EF	181	\$498,825	\$560,996	\$123,692
6	G	30	\$216,675	\$92,983	(\$0)
Totals		1178	\$3,651,121	\$3,651,121	

Source: Stanley Consultants

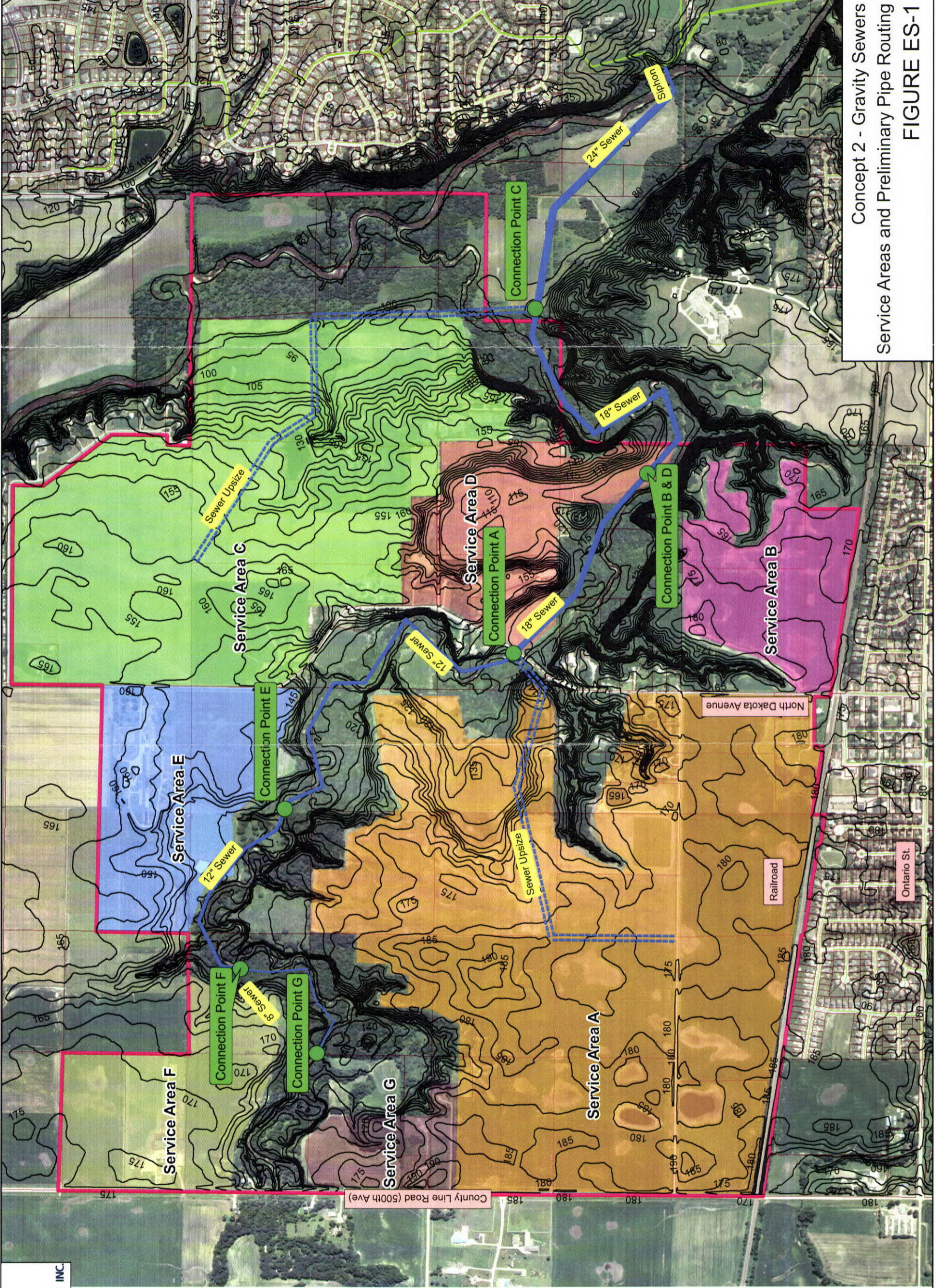
The table also shows the balance of funding required after each area pays for the full connection fee of \$3,100 per acre. Therefore, Area A requires \$2.057 million to provide sewer but will only be charged \$1.515 million in connection fees leaving a balance of \$541,000 to be carried forward. This funding gap would have to be financed by the City or developer as part of sewer district until all areas develop and all connection fees are collected.

Due to the findings of the environmental experts that acknowledge the high value of the existing woodland corridor, a buffer of 100 to 200 feet is recommended between the wooded areas and the residential lots. This buffer would help keep invasive plant species from entering the sensitive areas, protect animal habitats and provide a location to potentially manage storm water. This buffer could also be used for recreational trails to allow the public to enjoy the natural areas while preserving the existing high quality habitat.



Legend

- Connection Points
 - Northwest Growth Study Area
 - Property Lines
 - 5' Contours
- Preliminary Sewer Routes**
- Development Upsize
 - 8" Proposed Sewer
 - 12" Proposed Sewer
 - 18" Proposed Sewer
 - 24" Proposed Sewer
 - Siphon



Concept 2 - Gravity Sewers
Service Areas and Preliminary Pipe Routing
FIGURE ES-1

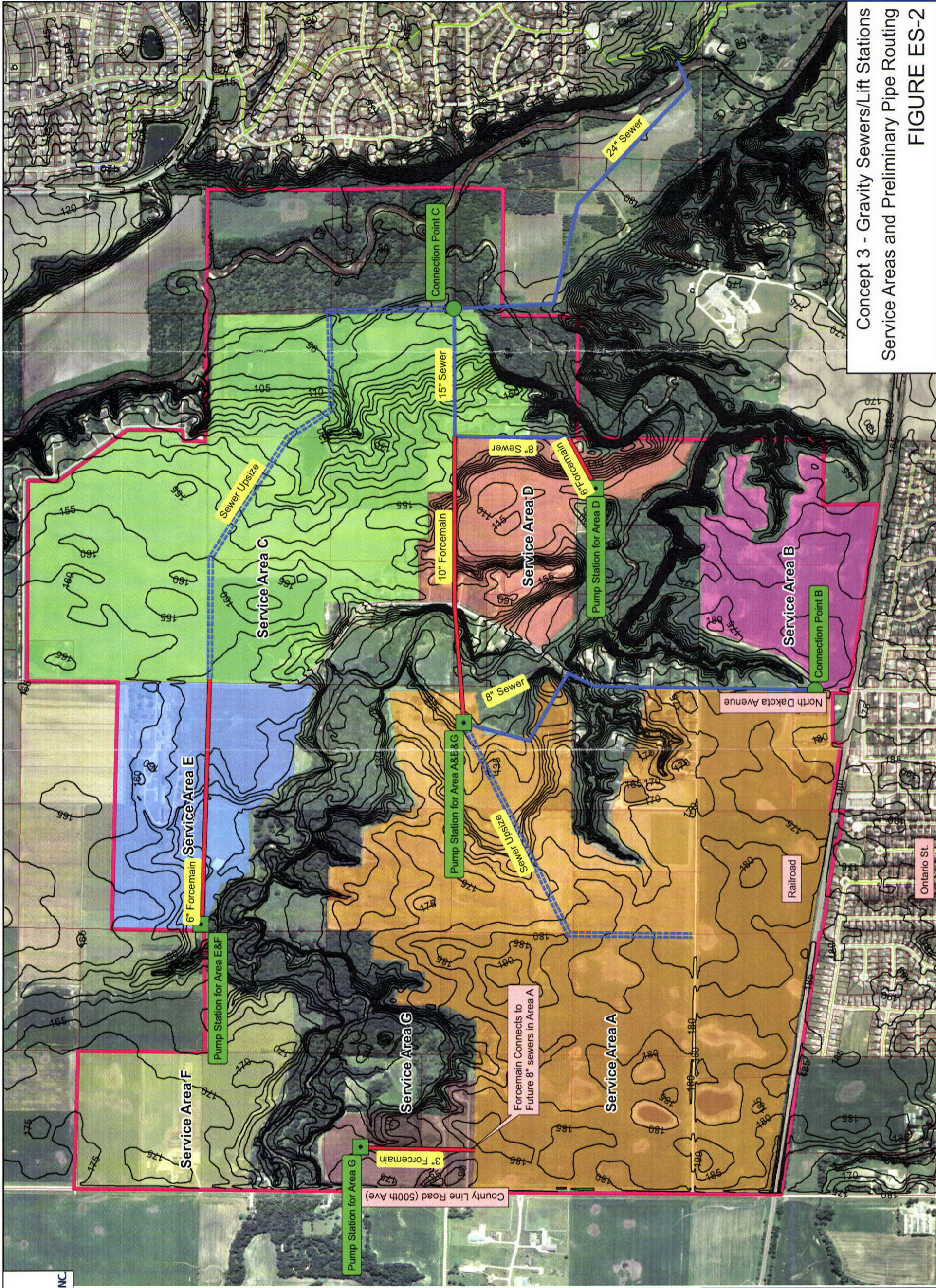


Legend

- Connection Points
- Pump Station Locations
- 5' Contours
- Northwest Growth Study Area
- Property Lines

Preliminary Sewer Routes

- FM
- Gravity
- Upsize



**Concept 3 - Gravity Sewers/Lift Stations
Service Areas and Preliminary Pipe Routing
FIGURE ES-2**