4.0 RECOMMENDED IMPROVEMENTS

HydroScience has developed recommended improvements based on the information gathered at the various site visits, with their specific inventories and assessments as presented in the previous chapters. It is anticipated that these recommendations will be used by others to develop a Capital Improvements Plan (CIP) to detail the specific budgets and timelines for both the City's sewage lift stations and stormwater drainage stations.

These recommendations have been made using a 20-year planning horizon (i.e. projects are anticipated to be completed within the next 20 years) and are arranged in order of priorities with the highest priority projects listed first.

For each project, preliminary construction budgets have been established based on similar projects. In addition, recommended next steps have been included to guide the CIP effort.

4.1 GUIDING PRINCIPLES

While developing and prioritizing specific recommendations, the following guiding principles were applied to each pumping site. Although listed as individual principles, many of these principles are overlapping in nature. They are also meant to inform, and not necessarily to quantify the decision making process.

Principle 1: The most problematic and immediate issues should be addressed first. Problematic issues include an inadequately sized pump station, safety concerns for the City's Staff or the general public, or regular and significant staff maintenance efforts.

> ***Example**: If a lift station is found to be undersized, and therefore incapable of keeping ahead of incoming flows, there is a clear danger of flooding of the incoming gravity sewers. Sewage flooding is a clear and immediate issue that would take precedence over other longer-term needs.*

Principle 2: Closely related to Principle 1 above, is the concept that municipalities should act to mitigate risk where the ratio of risk to project cost is highest. This concept is often spoken about in terms of getting the most benefit for any given expenditure.

***Example 1**: Adding a backup generator to a large pump station serving a densely populated area would be judged as alleviating more risk than the same size construction contract to build a replacement pump station for an aged and somewhat problematic pump station in a sparsely populated area. Note that, in this example, both needs must ultimately be addressed, however, the project that mitigates the greater risk for the same cost is prioritized.*

Principle 3: The oldest equipment within any system should, in general, be replaced before more recently installed equipment is replaced. This can be thought of as an extension of the previous principle in that systems and equipment should be replaced before they can age beyond their useful life and fail or become an ongoing maintenance issue. This principle is complicated because not all equipment within a system ages at the same rate and therefore engineering judgment is often required on a case-by-case basis.

***Example 1**: Control components, such as PLCs, become obsolete more quickly than other components within a pumping system. The replacement rate of control equipment is further complicated as the advantages of remote control are recognized and included in modern designs.*

***Example 2**: The planning horizon also figures into replacements based on age. For example, a pump station that had been in service for 50 years should be slated for replacement within the 20 year planning horizon based simply on service life because by the end of the planning horizon it would have been in service for 70 years.*

Principle 4: Lastly, progress toward standardization should also be considered within the planning process. This principle recognizes the advantages to a municipality resulting from standardization of equipment and operating procedures in terms of Staff training, equipment spares, and redundancy. While progress toward standardization has value, it is not often sufficient cause to justify an entire project on its own.

***Example**: The oldest three sewage lift stations within the City's collection system, built between 1964 and 1975, utilize dry pits to house the sewage pumps whereas the newer three stations, built between 1992 and 1997, utilized submersible pumps housed directly in the wet well. This trend toward submersible sewage pumps, while not universal, can*

be found in many municipalities. Given that the last three stations built use submersible pumps, this style of pump station should be considered the "City Standard" for sewage lift stations. It is therefore reasonable to assume that as lift stations are replaced they will be designed with submersible sewage pumps to continue this standard.

Summary: It is rare to have a single one of these principles cited as the sole driver for a large project. More commonly, multiple drivers such as station age, progress toward standardization, and risk, taken together, will dictate when and how any particular project becomes recommended and prioritized.

(This page intentionally left blank)

4.2 SEWAGE LIFT STATION (SLS) RECOMMENDATIONS

The following subsections present planning level recommendations for the City's sewage lift stations. Projects are presented in order of priority and are summarized in **Table 4.2** below.

Table 4.2 Sewage Lift Station Recommendation Summary

Project No. or Ranking	Description	Construction Estimate
1	Relocate and replace SLS #4	$1.3 to $2.0M
2	Replace (and possibly relocate) SLS #1	$1.5 to $2.3M
3	Replace SLS #3	$1.2 to $1.9M

Construction cost estimates do not include soft costs such as City internal costs, report preparation, design or contingency.

The remaining three sewage lift stations, SLS #2, SLS #5, and SLS #6, have been well maintained and are in good condition. These three stations are all self-cleaning lift stations with submersible sewage pumps built between 1992 and 1997, and all three lift stations have relatively small pumps (+/- 3 hp pumps) which could undergo electrical and controls upgrade modifications at any time.

With the exception of the tilted control building at SLS #6, which will require some ongoing monitoring, these three stations are unlikely to require significant expenditures beyond those normally associated with lift station maintenance. HydroScience recommends a planning level construction budget between $300,000 to $400,000 for each of these lift stations for ongoing electrical and controls upgrades as well as the minor items identified in the *Chapter 2* inventory tables.

4.2-1 PROJECT 1 - SEWAGE LIFT STATION #4

Sewage Lift Station #4 was constructed in 1971 before Fifth Street was extended to its current location. As Fifth Street was extended, a median was constructed around the lift station to maintain access to the station and to protect the upper portions of the station from vehicular traffic. This location creates station access issues for the City's staff as well as unnecessary conflicts with the general public.

Station in Median

Entrance to the station's dry pit requires a confined space entry. This increases the staff manpower efforts significantly over comparably sized stations.

In 1986, as part of a larger project, the lift station electrical equipment was relocated from the underground dry pit to an above ground site near the Corp Yard entrance. The distance between the control panel and pumping equipment in the dry well is unusually far and not in keeping with good design practices.

This station, built in 1971, is the second oldest station in the City's collection system. By the end of the planning horizon, this station, if not replaced, will have been in service for 63 years. This is beyond typical service life anticipated for this style of sewage lift station.

The configuration of this station does not comply with the City's default self-cleaning submersible sewage pump lift station standard.

Recommendation: For the reasons listed above, HydroScience recommends replacing the entire lift station with a self-cleaning submersible-pump station located within nearby the Corp Yard. By relocating the station within the Corp Yard, the existing station could be used for construction phase wastewater pumping, thus reducing the overall construction costs and risks.

Construction Estimate: $1.3 to $2.0M

Next Step: Pre-design Report

4.2-2 PROJECT 2 - SEWAGE LIFT STATION #1

The El Macero Sewage lift station (SLS #1) was constructed in 1975 at the site of an earlier pump station as part of a larger interceptor sewer project. At that time the electrical/controls building was constructed partially over the top of the earlier lift station. It appears that the then-existing lift station inadvertently supported the building slab on the west side while the site as a whole subsided. This has caused the building to tilt from east to west at approximately ½" per foot for a total tilt of approximately 10-inches. Measures were taken to stabilize the building and the tilting appears to have been halted. The tilt to the building is quite disconcerting and disorienting to anyone working inside the building and is therefore undesirable from a safety standpoint.

Entrance to the station's dry pit requires a confined space entry. This increases the Staff manpower efforts significantly over comparably sized stations.

This station, built in 1975, is the third oldest station in the City's collection system. By the end of the planning horizon the station, if not replaced, will have been in service for 59 years. This is beyond typical service life anticipated for this style of sewage lift station.

The configuration of this station does not comply with the City's default self-cleaning submersible sewage pump lift station standard.

The existing site is very small with little room for onsite staging during construction. Due to site constraints and the need for sewage pumping during construction, replacement of the station at the current location would be both difficult and expensive.

Recommendation: For the reasons listed above, HydroScience recommends replacing the entire lift station with a self-cleaning submersible-pump lift station. We also recommend that a feasibility study be undertaken to find a replacement site nearby due to the site constraints, in hopes that relocating the lift station could improve access for construction, operation, and maintenance, and thus reduce overall costs.

Construction Estimate: $1.7 to $2.5M (does not include cost of land if relocation possible)
Next Step: Feasibility Study and/or Pre-design Report

4.2-3 PROJECT 3 - SEWAGE LIFT STATION #3

This station, built in 1964, is the oldest lift station in the City's collection system. By the end of the planning horizon this station, if not replaced, will have been in service for 70 years. This is beyond typical service life anticipated for this style of sewage lift station.

Access to Station Dry Pit

Entrance to the station's dry pit requires a confined space entry. This increases the Staff manpower efforts significantly over comparably sized stations.

The distance between control panel in the fenced area and pumping equipment in the dry well is unusually far and not in keeping with good design practices.

The wet well is located approximately 60-feet away from the dry pit in the street. This location creates quarterly conflicts between Staff and vehicular traffic as the wet well is maintained. The distance between the wet well and dry pit also results in unusually long pump suction pipes. Both of these situations are not in keeping with good design practices.

The configuration of this station does not comply with the City's default self-cleaning submersible sewage pump lift station standard.

Recommendation: For the reasons listed above, HydroScience recommends replacing the entire lift station with a self-cleaning submersible-pump station. The current site will allow construction of a replacement station while maintaining the existing station for construction phase wastewater pumping.

Construction Estimate: $1.2 to $1.9M

Next Step: Pre-design Report

4.3 STORMWATER DRAINAGE STATION (SDS) RECOMMENDATIONS

The following presents planning level recommendations for the City's stormwater drainage stations. Projects are presented in order of priority.

Table 4.3 Stormwater Drainage Station Recommendation Summary

Project No. or Ranking	Description	Construction Estimate
1	Replace SDS #3	$7 to $12M
2	Upgrade (or replace) SDS #5	$3 to $5M
3	Replace SDS #6	$0.8 to $1.3M

Construction cost estimates do not include soft costs such as City internal costs, report preparation, design or contingency.

The remaining five stormwater drainage stations, SDS #1, SDS #2, SDS #4, SDS #7, and SDS #8 have been well maintained and are in good condition. These drain stations were built between 1980 and 2002 and could undergo electrical and controls upgrade modifications during any dry season.

These stations are unlikely to require significant expenditures beyond those normally associated with drainage station O&M costs. HydroScience recommends a planning level construction budget of $300,000 to $400,000 for each of these drain stations for ongoing electrical and controls upgrades as well as the minor items identified in the *Chapter 3* inventory tables.

4.3-1 PROJECT 1 - STORMWATER DRAINAGE STATION #3

This station is the largest drainage station in the City's stormwater system. At a nominal capacity of 200,000 gpm, this station is almost twice the size of all the other drainage stations combined.

Typical stormwater pump

The report entitled "1991 Sewer and Strom Drainage Facilities Evaluation and Master Planning Study" dated October 1991 stated that, even with all four pumps in operation, the station did not meet the estimated 100-year flow requirements. Anecdotal evidence from Staff confirms that this station is inadequately sized to meet the required capacity.

When the overpass adjacent to the station was constructed, an unusual soil load was placed against the structure. An analysis of this additional load calls into question the structural integrity of the building under a seismic event.

This station is the only stormwater drainage station equipped with diesel powered pumps. Diesel powered pumps do not lend themselves to backup power in the same manner that electrically powered pumps do (with a backup generator replacing the utility power supply in the event of a power failure). This leaves this station, the most important in the City's collection system, without a source of backup power. This represents a clear and significant risk to the City.


Embankment against structure.

As noted above, the capacity of this drain station represents approximately two-thirds of the pumping capacity within the City's stormwater system. A failure at this station in even a relatively minor event could cause significant flood damage.

Built in 1945, this station is the second oldest station in the City's drainage system. By the end of the planning horizon this station, if not replaced, will have been in service for 89 years. This is well beyond typical service life of a stormwater drainage station.

Recommendations: For the reasons listed above, HydroScience recommends replacing and upgrading the H Street Station as soon as possible. Given the limited space available at the current site and the need for stormwater pumping during construction, HydroScience recommends a comprehensive feasibility study effort be undertaken of the collections system to determine if this station could be replaced by multiple smaller stations strategically located throughout the collection system. The feasibility study should also consider upgrading this station to include self-cleaning screens to protect the pumps.

Construction Estimate: $7 to $12M

Next Step: Feasibility Study

4.3-2 PROJECT 2 - STORMWATER DRAINAGE STATION #5

At a nominal capacity of 62,000 gpm, this station is the second largest drain station in the City's stormwater system. It is the City's only stormwater drainage station south of Interstate 80. This station was constructed in 1965 by Assessment District No. 105 as part of the Yolo County El Macero District Drainage and subsequently taken over by the City sometime before 1991. Note that the 1992 report entitled "South Davis Storm Drainage Hydologic and Hydraulic Evaluation" estimated only 55% of the flow at this station originated in urban areas of the City with the remaining 45% of the flow originating in the agricultural areas between the City and the drainage station.

Plate across building door

The electrical/controls building has been subject to flooding for some time. To mitigate this issue, a metal plate was installed across the building door. This is an impediment to safe operation and should be removed and replaced with another means of flood protection as soon as possible.

The open channel to drainage station has sediment issues which require significant effort by the City's Staff each year. Isolation gates could likely be engineered to help mitigate this issue and reduce the yearly cleaning efforts. Note that the sediment appears to originate from the agricultural areas between the City limits and the drain station.

Station screens

This station, built in 1965, is the third oldest station in the City's drainage system. By the end of the planning horizon this station, if not replaced, will have been in service for 69 years. This is near the typical service life of a stormwater drainage station of this configuration.

The previously mentioned 1991 Hydraulic Evaluation noted that, with all pumps in service, the station was only capable of discharging the equivalent of a 10-year

discharge event. This flow limitation is noted as acceptable because flooding from higher flows would be limited to agricultural lands and would not impact upstream urban areas.

Unlike the other stormwater drainage stations within the City's stormwater management system, there is no clear path forward for this station. Issues to consider include:

- This is the only station in the City's system responsible for substantial flows from areas outside the City's urban area.
- The station clearly needs upgrades to the electrical system to remain reliable and modifications to the supply channel to mitigate the ongoing costs due to sediment runoff from agricultural lands.
- The current system reportedly provides better than 200-year flood protection for the urban areas by gravity (i.e. a station is not needed to drain the urban areas).
- The required peak instantaneous flows are significantly reduced due to the acceptability of overflows in the agricultural areas surrounding the drainage station itself.
- The station will have been in service for 69 years at the close of the planning horizon therefore a plan should be in place for replacing the drainage station by the end of that period.

Recommendations:

Alternate 1: We recommend upgrades to the El Macero Drainage Station to raise and relocate the electrical/controls building by 6-feet while relocating the building closer to the levee. These changes will protect the electrical equipment from flooding and allow for access to the building during flood events. We also recommend modifying the supply channel to include gates to facilitate yearly maintenance activities.

Alternate 2: A Feasibility Study could be undertaken to consider construction of drainage station at or near the City limits along the existing drainage channel and allow the City to return operation of the existing station to the local drainage district. This, if possible, would decouple the urban drainage areas from the agricultural drainage areas. It is unclear if a discharge forcemain would be required or if the existing levee system supports this approach.

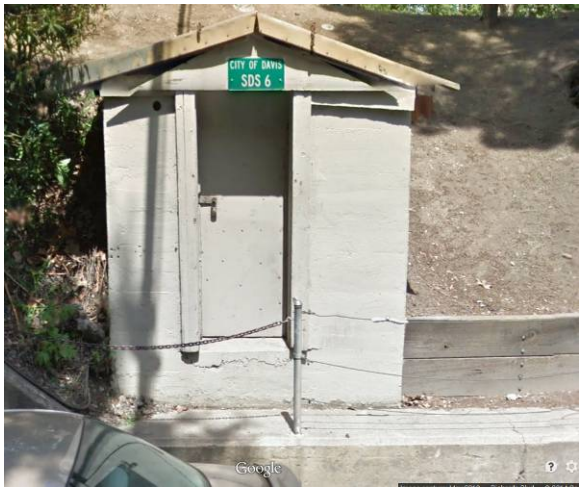
Alternate 3: A Feasibility Study could be undertaken to consider alternate methods for either controlling or managing the sediment entering the open channel. Alternatives for sediment control might include setbacks on both sides of the channel to reduce sediment laden runoff into the channel or a large sediment receiving pond ahead of the station.

Construction Estimate: $3 to $5M (Alternate 1)

Next Step: Pre-design report

4.3-3 PROJECT 3 – STORMWATER DRAINAGE STATION #6

The Richards Undercrossing storm drainage station, SDS #6, located at 1000 Olive Drive, on the southeast side of the Richards Boulevard railway underpass, is the oldest station in the City's stormwater system. At a nominal capacity of 314 gpm this station is also the smallest drainage station.



Pump Station Building

Access to the pump building is difficult and far below what is generally recognized as the minimum acceptable access required for operations and maintenance.

By the end of the planning horizon this station, built between 1920 and 1930 will have been in service for over 100-years. This is far beyond typical service life of a stormwater drainage station.

Recommendation: HydroScience recommends replacing the Richards Undercrossing storm drainage station with a precast pump station located nearby on City property.

Construction Estimate: $0.8 to $1.3M

Next Step: Pre-design report