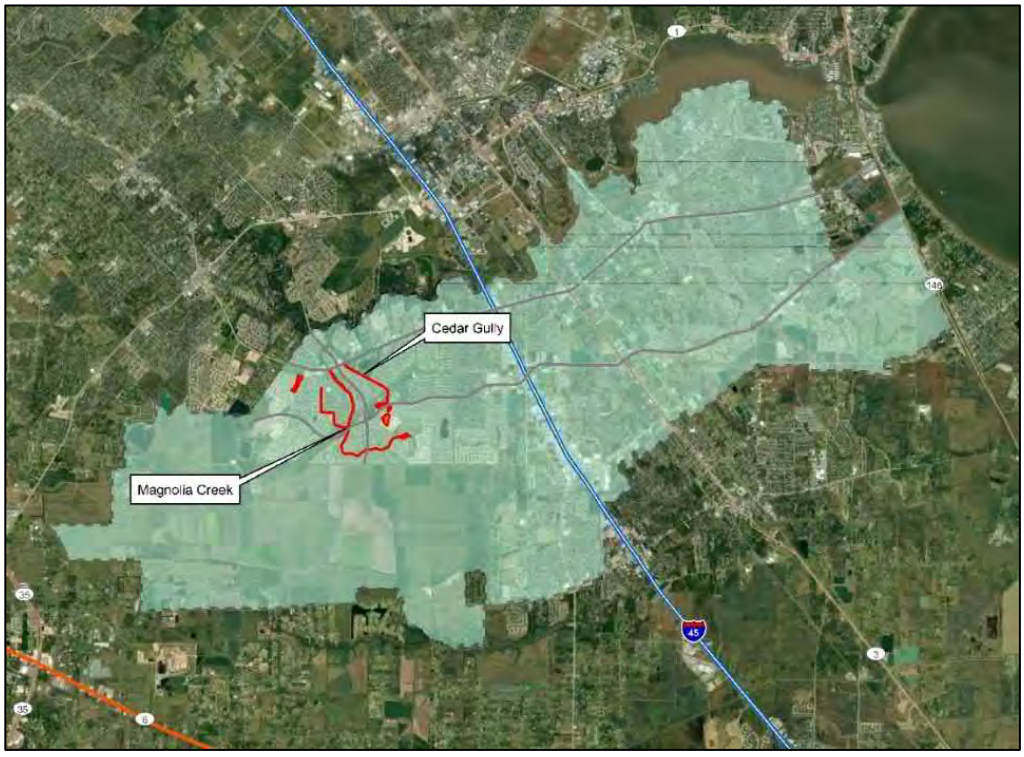
Received 26 January 2022

City of League City
Magnolia Creek and Cedar Gully Channel Improvement Project
Alternatives Analysis
January 13, 2021

Introduction

Kimley-Horn and Associates, Inc. (Kimley-Horn, the Authorized Agent) has prepared this Alternatives Analysis to support an Individual Permit application for your review and consideration for construction activities within Waters of the U.S. in association with channel improvements proposed to Magnolia Creek and Cedar Gully and an existing detention basin. The City of League City, (the City, the Applicant) retained Kimley-Horn to analyze and propose potential improvements for Magnolia Creek, Cedar Gully, and one detention basin located within the Magnolia Creek watershed. The methodology and results of this analysis is documented in a drainage modeling summary report dated May 2020. The drainage modeling summary report is available upon request. The study area is located west of Interstate 45 in the northwestern quadrant of the City limits (site or study area). The study area in relation to the City of League City limits is shown in Figure 1 below.

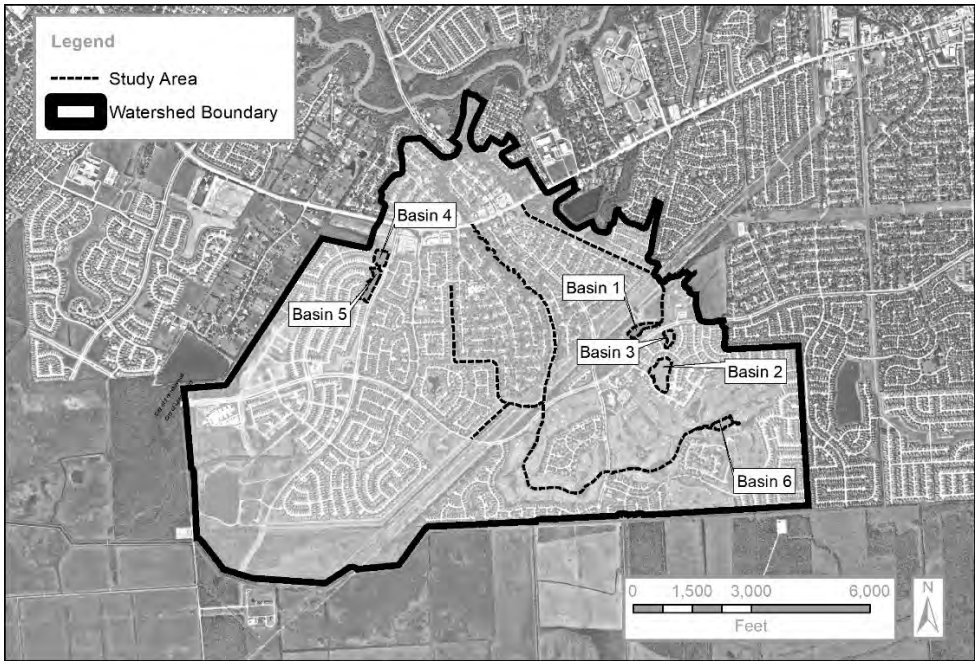
Figure 1: Study Area Location within League City Limits



The study area within the Magnolia Creek watershed is shown in Figure 2 below.

Received 26 January 2022

Figure 2: Study Area Location within Magnolia Creek Watershed



Need and Purpose:

There is a local need within the Magnolia Creek watershed to accommodate anticipated peak flows based on NOAA Atlas 14 rainfall data as the area is regularly experiencing localized flooding which poses a safety concern for area residents. Specifically, the Westover Park, Countryside, Magnolia Creek, Rustic Oaks, and Jensen Colony subdivisions are currently affected by the insufficient conveyance conditions. Given that storm events previously categorized as 100-year storm events are happening much more frequently and are now considered 25-year storm events, improvements need to be performed to accommodate anticipated peak flows. Another aspect of the project is correcting failed erosion control structures and stabilizing side-slopes. These corrections will increase long-term channel stability, reduce long-term maintenance costs, and maintain flood control function of the channels.

The proposed project includes channel improvements including desnagging, regrading, and widening portions of the channels. The purpose of the proposed project is to restore the function of the channels to their original design and provide enough capacity to accommodate the anticipated peak flows in the Magnolia Creek watershed to reduce flooding risk to the residents and property residing within the subdivisions within the Magnolia Creek watershed.

Upon project completion, areas currently classified as wetlands will function as streams, which are generally considered to be of higher quality than wetlands. Areas within Magnolia Creek and Cedar Gully observed to function as streams while performing the aquatic resources delineation will continue to function as streams upon project completion. The project is proposed to restore the function of the channels to their original design and provide enough capacity to accommodate the anticipated peak flows in the Magnolia Creek watershed. Natural stream design procedures

are being incorporated into the design of the proposed project including but not limited to riffle and pool complexes. Significant adverse effects are not anticipated from the proposed project.

Beneficial effects include decrease in flooding in the affected subdivisions located within the Magnolia Creek watershed. The proposed project will bring the drainage system up to current standards following studies from Hurricane Harvey flooding. Temporary construction disturbance will be minimized through the use of appropriate best management practices. Further, construction access areas are proposed to avoid additional impacts to Waters of the U.S. Erosion control methods will be utilized to control sedimentation from traveling downstream.

Alternatives

No Action Alternatives

The Applicant approached the analysis of the No-Action Alternative in two ways. For the first, the Applicant assumed that no channel improvements would occur. In this scenario, the need for flooding protection within the Magnolia Creek watershed would remain. The drainage system would not accommodate anticipated peak flows based on NOAA Atlas 14 rainfall data. Although this No-Action Alternative would avoid all impacts to Waters of the U.S., it would not meet the need and purpose of the proposed project and is therefore not practicable.

In a second No Action Alternative scenario, the Applicant would seek to minimize flooding within the Magnolia Creek watershed while fully avoiding all onsite aquatic resources, meaning that no U.S. Army Corps of Engineers (USACE) permitting would be required.

Given the spatial layout of Waters of the U.S. on the study area and lack of sufficient City right-of-way (ROW) for work to occur outside of Waters of the U.S., the full avoidance alternative is not practicable to minimize flooding in the Magnolia Creek watershed. Under this scenario, the drainage system would not accommodate anticipated peak flows based on NOAA Atlas 14 rainfall data. Therefore, localized flooding would remain.

Thus, because the No Action Alternatives would not meet the project's need and purpose, the Applicant found them impracticable.

Offsite Alternatives

The Applicant seeks to make improvements within the Magnolia Creek and Cedar Gully channels and minor improvements within one existing detention basin located within the Magnolia Creek watershed given the demonstrated need for the area to accommodate peak flows based on NOAA Atlas 14 rainfall data and thus reduce flood risk for area residents. Prior to designing the proposed project within the current study area, the Applicant undertook a search within the Magnolia Creek watershed for other potential offsite alternatives. The Applicant searched for a site that met the following criteria:

1. Located within the Magnolia Creek watershed;
2. Located within existing City of League City right-of-way to avoid costly land acquisition;
3. Located on property that is not developed with commercial buildings or residential dwellings to avoid business and/or home displacements for area residents and employers;

Received 26 January 2022

4. Located in an area that would allow for construction and maintenance access areas that would not impact Waters of the U.S.; and
5. Located low enough in the Magnolia Creek to provide hydraulic function and positive drainage (i.e. not located in the top of the watershed).

Offsite Alternative 1

The only offsite alternative that was considered was to construct additional large detention basins within the Magnolia Creek watershed. Constructing additional detention basins would provide additional flood storage within the Magnolia Creek Watershed. It was found that Offsite Alternative 1 did not meet all of the siting criteria provided above. Justifications are provided below.

1. This criterion would be met for Offsite Alternative 1 as the detention basins would be required to be constructed within the Magnolia Creek watershed in order to ensure the watershed could accommodate peak flows and create additional flood storage.
2. The City of League City does not have sufficient ROW within the Magnolia Creek watershed to allow for the construction of detention basins. Therefore, in order for Offsite Alternative 1 to be implemented, costly land acquisition would be required, which would likely require eminent domain. Therefore, siting criterion 2 would not be met.
3. Sufficient undeveloped land that would not be required to be acquired within the Magnolia Creek watershed does not exist. Therefore, in order to construct additional detention basins, commercial buildings and/or residential dwellings would be required to be displaced following costly acquisition (criterion 3).
4. This criterion would be met as it is reasonable to expect that additional detention basins could be constructed in areas that would not require impacts to Waters of the U.S. associated with construction and maintenance access.
5. It is reasonable to expect that this criterion could be met if new detention basin locations were selected in a low portion of the Magnolia Creek watershed.

Given that Offsite Alternative 1 does not meet all of the siting criteria, it was dismissed from further consideration. While Offsite Alternative 1 may meet the need and purpose of the project, it is not the least environmentally damaging practicable alternative (LEDPA).

Onsite Alternatives

Onsite Alternative 1 (Preferred Alternative)

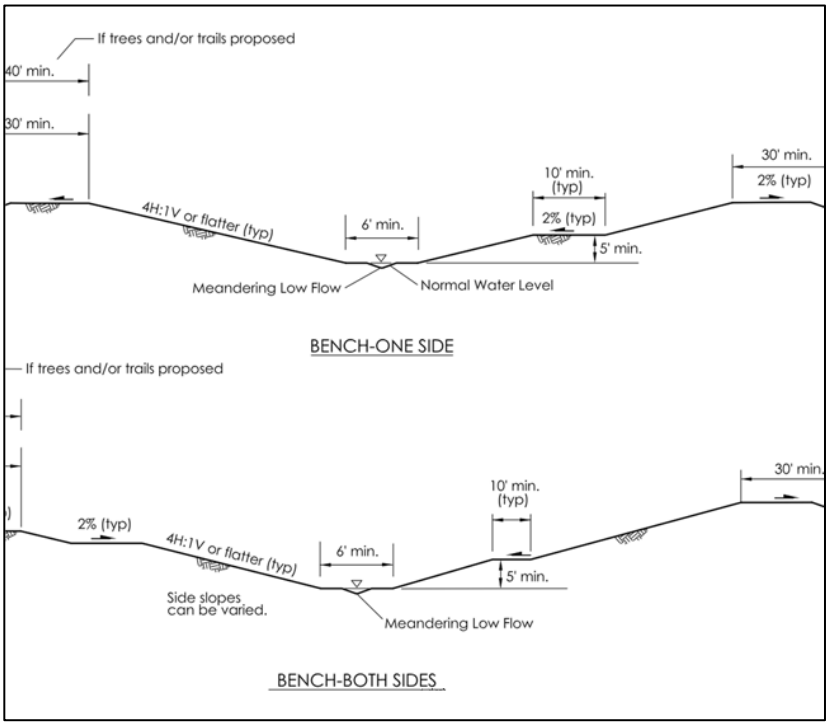
The Preferred Alternative includes channel improvements including desnagging, regrading, and widening within the Magnolia Creek and Cedar Gully channels, along with minor improvements to one existing detention basin. Magnolia Creek and Cedar Gully are the major watercourses located within the Magnolia Creek watershed and they are not functioning as they were intended. The Preferred Alternative will restore the functions of the channels to their original design and will provide enough capacity to accommodate the anticipated peak flows in the watershed based on NOAA Atlas 14 rainfall data to reduce flooding risk to the residents within the Westover Park, Countryside, Magnolia Creek, Rustic Oaks, and Jensen Colony subdivisions. The Preferred Alternative is located on approximately 92 acres of undeveloped land that is owned by the City of League City.

The proposed project would result in direct impacts to 7,361 linear feet and 1.72 acres of streams (759 linear feet and 0.36 acre of intermittent streams and 6,602 linear feet and 1.36 acre of perennial streams); 4.22 acres of emergent wetlands; and 0.1 acre of open water features. Impacts to the streams and wetlands will be due to desnagging, regrading, channel widening, and the installation/replacement of culverts. As proposed, the project would totally avoid impacts to 4,778 linear feet and 1.18 acre of streams, 7.53 acres of emergent wetlands, and 21.46 acres of open water features. Additionally, following construction of the proposed project, the new Magnolia Creek and Cedar Gully channels that will be impacted will measure a total of 11,469 linear feet and 3.16 acres of stream instead of a mixture of perennial streams, intermittent streams, and emergent wetlands. It is anticipated that the stream flow regime will be perennial as the flow will be improved and returned to the intended design. It is generally understood that perennial streams are typically considered of higher quality than intermittent streams and wetlands. Natural stream design procedures are being incorporated into the design of the proposed project including but not limited to riffle and pool complexes. Additionally, impacts to open water features have been limited to the minimum amount necessary (0.1 acre) and are considered to be very minor in nature. Project plans can be found as Attachment A to the Individual Permit application cover letter.

With the widening of channels and associated grading, streambank stabilization will be critical to the success of the project. Harris County Flood Control District (HCFCD) manuals and standards were reviewed, referenced, and are being incorporated into the project design. Although the project is not located within Harris County, Harris County has experienced significant development that has caused the HCFCD to incorporate creative flood solutions into the development framework of the region. Further, the project-neighboring Harris County experienced devastating flooding with Hurricane Harvey, similar to Galveston County. Therefore, HCFCD manuals and standards are appropriate to be referenced and incorporated into the proposed project. According to the HCFCD Streambank Stabilization handbook streambank stabilization techniques are often divided into two general categories of techniques: structural and bioengineering. Structural techniques include articulating concrete blocks, stone riprap, sand-cement bags, retaining walls, and sheet walls. Bioengineering combines traditional engineering methods with the use of grasses, trees, or other living plant materials to stabilize and protect the streambank. Bioengineering techniques often cost less than structural techniques, are self-sustaining once established, and can become more effective with time. A perceived drawback to bioengineering is that it requires ongoing maintenance. Vegetation is a critical component of streambank stabilization. Vegetation growing on the streambank helps to dissipate stream flow and energy, protecting the surface from erosion. Streambank vegetation can also help direct high energy stream flows towards the center of the stream channel and reduce stream flow velocities and streambank stresses. Vegetative streambank stabilization is proposed to be utilized within the Magnolia Creek and Cedar Gully channels. Many streambanks that have been hardened with a structural stabilizing technique, such as concrete revetments, sheet piles, articulating concrete blocks, and retaining walls have failed over time and, in some cases, are contributing to further streambank erosion upstream and more frequently downstream. Therefore, proposed bioengineering techniques for the proposed project should be considered minimization measures by avoiding the use of structural techniques. An example of a grass-lined bench channel similar to the Preferred Alternative is provided below.

Received 26 January 2022

Figure 3: Example Grass-Lined Bench Cross-Section

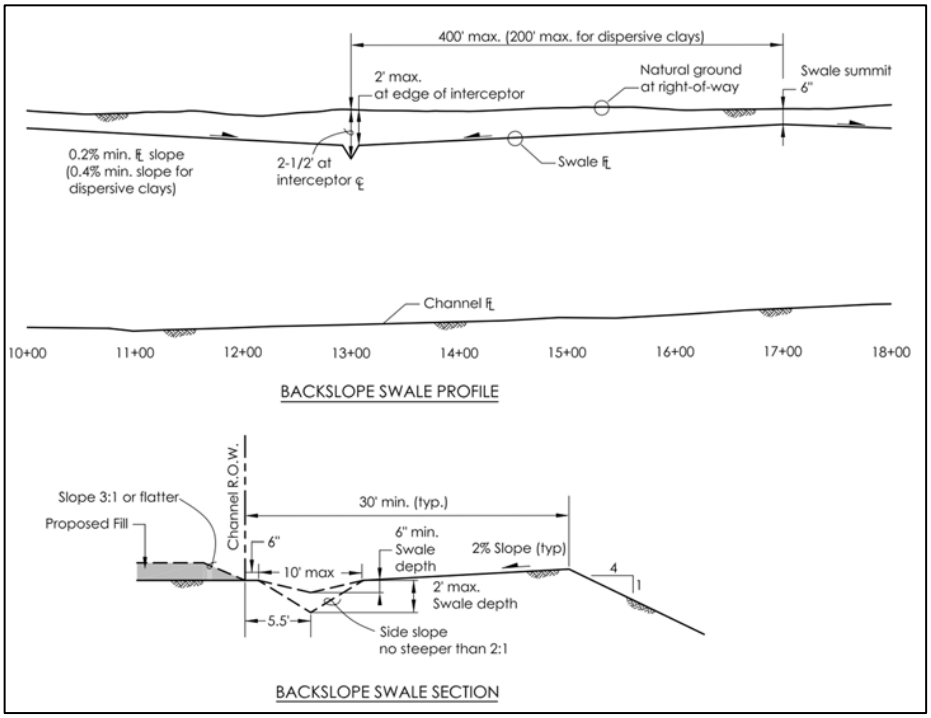


Onsite Alternative 2 – Total Avoidance Alternative

Under this Alternative, the Applicant explored options to construct backslope interceptors or other bench ditch features in uplands outside the ordinary high water mark of the Magnolia Creek and Cedar Gully channels. An example cross-section of this Alternative is provided below.

Received 26 January 2022

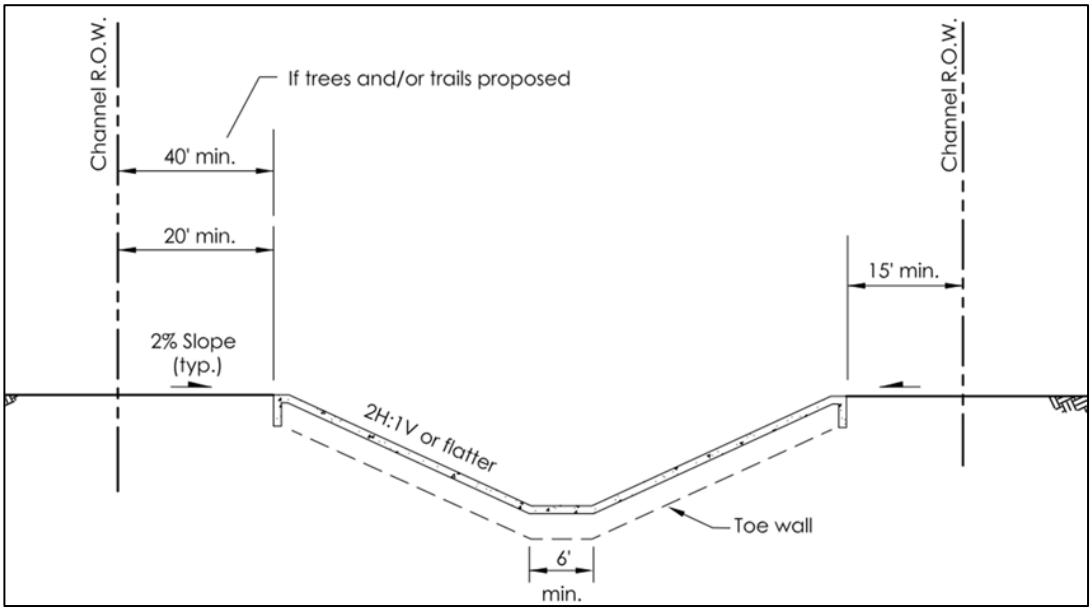
Figure 4: Example Backslope Interceptor Cross-Section



Onsite Alternative 3 – Concrete Trapezoidal Channels

Under this Alternative, the Magnolia Creek and Cedar Gully channels would still be widened and straightened in places; however, the side slopes and channel bottom would consist entirely of concrete. A typical cross-section of this Alternative is provided below.

Figure 5: Example Concrete Trapezoidal Cross-Section



Onsite Alternative 4 – Gabion Basket Trapezoidal Channels

Under this Alternative, the Magnolia Creek and Cedar Gully channels would still be widened and straightened in places; however, the side slopes and channel bottom would consist entirely of gabion baskets.

Onsite Alternatives Analysis

The Applicant undertook an analysis of alternative designs for the Preferred Alternative site to determine the optimal design that would fulfill the project's need and purpose while avoiding and minimizing adverse impacts to aquatic features to the extent practicable while meeting the required practicability factors. The critical elements or practicability factors that were evaluated are provided below.

1. Provide enough surface area to accommodate anticipated peak flows;
2. Retain the natural resource functions of the Magnolia Creek and Cedar Gully channels when considering:
    a. Channel condition;
    b. Riparian buffer;
    c. Aquatic life use; and
    d. Channel alteration.
3. Keep natural aesthetic value of the Magnolia Creek and Cedar Gully channels;
4. Be constructible in terms of work within existing City of League City ROW;
5. Provide a design solution that does not significantly increase the velocity, timing, and severity of flow and minimizes water quality concerns; and
6. Consist of techniques proven to self-sustain and minimize maintenance when considering bank stabilization efforts.
7. Provides increased safety to the area residents by reducing flooding risk.

Table 1, below, is a summary of each onsite alternative's compliance with the practicability factors used to select the preferred alternative.

Received 26 January 2022

Table 1: Onsite Alternatives Comparison Matrix

Practicability Factor	Onsite Alternative 1 (Preferred Alternative)	Onsite Alternative 2	Onsite Alternative 3	Onsite Alternative 4
1. Enough surface area to accommodate anticipated peak flows	Yes	No	Yes	Yes
	Based on drainage modeling, there is enough surface area to allow for improvements to accommodate anticipated peak flows.	There is not enough surface area within the study area boundaries to install backslope interceptors (or similar features) without acquiring additional property.	The geometry of a concrete-lined channel would allow for steeper banks than Onsite Alternative 1; therefore, there is enough surface area to construct concrete-lined channels.	The geometry of a gabion basket lined channel would allow for steeper banks than Onsite Alternative 1; therefore, there is enough surface area to construct concrete-lined channels.
2. Retain natural resource functions	Yes	Yes	No	No
	Natural stream channel design measures are being incorporated into the design including riffle and pool complexes. The banks will remain vegetated. Channel condition will be suboptimal (score of 4 on Level 1 Stream Condition Assessment). A riparian buffer will be present within the study area post-construction. Some trees will need to be cleared to allow for adequate flow; however, this will be minimized. The banks will also remain vegetated to provide additional vegetated riparian buffer. Aquatic life will continue to use the study area following construction. Aquatic life use will be suboptimal (score of 4 on Level 1 Stream Condition Assessment) because the channels will function as perennial streams. Following channel alteration, the channels will continue to recover and stabilize. This Alternative would also improve sections of inefficient degraded channels.	The channels would not be impacted under this Alternative. The banks would remain vegetated and channel condition would likely be suboptimal or optimal (scores of 4 or 5 on Level 1 Stream Condition Assessment. A riparian buffer would be present; however, this alternative would require more impact to the existing riparian buffer, especially wooded areas, to construct backslope interceptors. Aquatic life would continue to use the study area following construction. This Alternative would not result in channel alteration; however, it also would not improve degraded channel conditions like Onsite Alternative 1 would.	Under this Alternative, the channels would not be natural at any point and natural stream channel design measures would not be incorporated into the construction activities. The banks will not be vegetated. Channel condition would be marginal at best (score of 3 on Level 1 Stream Condition Assessment). A riparian buffer would likely remain under this Alternative; however, there would be a sharp change from concrete to vegetation. Aquatic life use would be poor at best (score of 2 on Level 1 Stream Condition Assessment) as concrete-lined channels don't provide beneficial aquatic life habitats. The channels would be entirely hardscaped and channel alteration would be significant.	Under this Alternative, the channels would not be natural at any point and natural stream channel design measures would not be incorporated into the construction activities. The banks will not be vegetated. Channel condition would be marginal at best (score of 3 on Level 1 Stream Condition Assessment). A riparian buffer would likely remain under this Alternative; however, there would be a sharp change from gabion baskets to vegetation. Aquatic life use would be poor at best (score of 2 on Level 1 Stream Condition Assessment) as gabion basket lined channels don't provide beneficial aquatic life habitats. The channels would be entirely hardscaped and channel alteration would be significant.
3. Keep natural aesthetic value of Magnolia Creek and Cedar Gully channels	Yes	Yes	No	No
	Natural stream channel design measures will be incorporated into this Alternative. Tree removal will be minimized to the maximum extent practicable to keep natural aesthetic value of the channels. The channels will also still contain some sinuosity that will be aesthetically pleasing for area residents. Aquatic life will continue to use the area which allows for more wildlife viewing.	Under this Alternative, additional modifications to the riparian areas would likely occur, which could affect the aesthetic value of the channels more than Onsite Alternative 1. However, given that there would be no impacts to the channels, channel present aesthetic value of the channels themselves would not change. Aquatic life will continue to use the area which allows for more wildlife viewing.	Under this Alternative, no natural stream channel design measures would be incorporated. The entire channels and banks would be hardscaped with concrete, which is not aesthetically pleasing. Aquatic life would not use this area as much, which also negatively affects aesthetic value and wildlife viewing.	Under this Alternative, no natural stream channel design measures would be incorporated. The entire channels and banks would be hardscaped with gabion baskets, which are not aesthetically pleasing. Aquatic life would not use this area as much, which also negatively affects aesthetic value and wildlife viewing.

Received 26 January 2022

4. Be constructible within existing City of League City ROW	Yes This Alternative is located entirely within City of League City ROW and is constructible within the limits of ROW.	No This Alternative would require additional ROW than what is available in order to provide additional benches and backslope interceptor channel construction areas. Additional ROW would need to be acquired.	Yes This Alternative would be located entirely within City of League City ROW and is constructible within the limits of ROW.	Yes This Alternative would be located entirely within City of League City ROW and is constructible within the limits of ROW.
5. Provide a design solution that does not significantly increase the velocity, timing, and severity of flow and minimizes water quality and erosion concerns	Yes This Alternative includes bioengineering techniques that will not significantly increase the velocity, timing, and severity of flow. This will also minimize water quality concerns as the vegetated channels will help filter sediment. Vegetation helps to dissipate stream flow and energy, protecting the surface from erosion.	Yes This Alternative would likely not increase the velocity, timing, and severity of flow and would minimize water quality concerns as the channels would not be impacted. However, it is reasonable to expect that erosion will continue to occur as banks will not be stabilized.	No This Alternative would result in a concrete-lined channel that would significantly increase the velocity, timing, and severity of flow. Additionally, water quality concerns would occur under this Alternative as sediment would not be filtered. Further, the hardscaped channels may result in additional downstream offsite streambank erosion based on increased velocities and flows.	No This Alternative would result in a gabion basket lined channel that would significantly increase the velocity, timing, and severity of flow. Additionally, water quality concerns would occur under this Alternative as sediment would not be filtered. Further, the hardscaped channels may result in additional downstream offsite streambank erosion based on increased velocities and flows.
6. Consist of techniques proven to self-sustain and minimize maintenance when considering bank stabilization efforts	Yes This Alternative includes bioengineering techniques that will be self-sustaining and will become more effective over time. This Alternative will also increase long-term channel stability, reduce long-term maintenance costs, and maintain flood control function of the channels.	Yes This Alternative would likely self-sustain, and maintenance would be minimized. Bank stabilization efforts would not be incorporated into this Alternative; however, maintenance would be required for the constructed backslope interceptors.	No This Alternative would likely result in frequent maintenance measures to sustain the integrity of the channels. In this region, it has been demonstrated that high velocities in concrete-lined channels can result in sections breaking off and moving downstream creating localized erosion problems.	No This Alternative would likely result in frequent maintenance measures to sustain the integrity of the channels. In this region, it has been demonstrated that high velocities in gabion basket lined channels can result in sections breaking off and moving downstream creating localized erosion problems.
7. Provides increased safety by reducing flooding risk	Yes As demonstrated through the drainage modeling performed, this Alternative would reduce flooding risk which would increase safety to area residents.	Yes This Alternative would reduce flooding risk which would increase safety to area residents.	No Concrete-lined channels would reduce the roughness of the channels and result in increased velocity and flows that could push flooding concerns further downstream outside of the project area.	No Gabion basket lined channels would reduce the roughness of the channels and result in increased velocity and flows that could push flooding concerns further downstream outside of the project area.
8. Avoid and minimize impacts to Waters of the U.S.	Yes This Alternative has been designed to avoid and minimize impacts to Waters of the U.S. while meeting the project's need and purpose. Upon project completion, areas currently classified as wetlands will function as streams, which are generally considered to be of higher quality than wetlands. Areas within Magnolia Creek and Cedar Gully observed to	Yes This Alternative would avoid impacts to Waters of the U.S. while meeting the project's need and purpose.	No The integrity of the channels would be completely affected, and the construction activities would leave low functioning post-construction channels. This Alternative would result in significantly greater impacts to Waters of the U.S. by converting natural stream channels	No The integrity of the channels would be completely affected, and the construction activities would leave low functioning post-construction channels. This Alternative would result in significantly greater impacts to Waters of the U.S. by converting natural stream channels

	function as streams while performing the aquatic resources delineation will continue to function as streams upon project completion. The project is proposed to restore the function of the channels to their original design and provide enough capacity to accommodate the anticipated peak flows in the Magnolia Creek watershed. Natural stream design procedures are being incorporated into the design of the proposed project including but not limited to riffle and pool complexes. Significant adverse effects are not anticipated from the proposed project. Upon project completion as proposed, approximately 14,880 linear feet and 38.05 acres of likely perennial streams will be present within the study area, instead of a mixture of perennial streams, intermittent streams, and emergent wetlands. It is generally understood that perennial streams are typically considered of higher quality than intermittent streams and wetlands.		to concrete-lined man-made channels.	to concrete-lined man-made channels.

Justification for the Preferred Alternative

There are several critical items which led to the selection of the Preferred Alternative. The justification for Applicant's preferred site is provided below:

1. The site had to be located within the Magnolia Creek watershed. The Preferred Alternative is located within the Magnolia Creek watershed.
2. The site had to be located within existing City of League City ROW to avoid costly land acquisition. The Preferred Alternative is located within City of League City ROW and costly land acquisition will not be required to meet the need and purpose of the project.
3. The site had to be located on property that is not developed with commercial buildings or residential dwellings to avoid business and/or home displacements for area residents and employers. The Preferred Alternative is located on undeveloped land and would not require commercial or residential displacements.
4. The site had to be located in an area that would allow for construction and maintenance access areas that would not impact Waters of the U.S. Construction and maintenance access areas for the Preferred Alternative have been designed to avoid impacts to Waters of the U.S.
5. The site had to be located low enough in the Magnolia Creek watershed to provide hydraulic function and positive drainage (i.e. not located in the top of the watershed). The

Preferred Alternative is located in a low area of the Magnolia Creek watershed to allow for positive drainage.

6. The site had to provide enough surface area to accommodate anticipated peak flows. Based on drainage modeling, there is enough surface area to allow for improvements proposed as the Preferred Alternative to accommodate anticipated peak flows.

7. The project design had to retain the natural resource functions of the Magnolia Creek and Cedar Gully channels when considering channel condition, riparian buffer, aquatic life use, and channel alteration (consistent with the Level 1 Stream Condition Assessment). Information below is based on the Preferred Alternative:

    a. Channel condition: Natural stream channel design measures are being incorporated into the design including riffle and pool complexes. The banks will remain vegetated. Channel condition will be suboptimal (score of 4 on Level 1 Stream Condition Assessment).

    b. Riparian buffer: A riparian buffer will be present within the study area post-construction. Some trees will need to be cleared to allow for adequate flow; however, this will be minimized. The banks will also remain vegetated to provide additional vegetated riparian buffer.

    c. Aquatic life use: Aquatic life will continue to use the study area following construction. Aquatic life use will be suboptimal (score of 4 on Level 1 Stream Condition Assessment) because the channels will function as perennial streams.

    d. Channel alteration: Following channel alteration, the channels will continue to recover and stabilize. This Alternative would also improve sections of inefficient degraded channels.

8. The project design had to keep natural aesthetic value of the Magnolia Creek and Cedar Gully channels. Natural stream channel design measures will be incorporated into the Preferred Alternative. Tree removal will be minimized to the maximum extent practicable to keep natural aesthetic value of the channels. The channels will also still contain some sinuosity that will be aesthetically pleasing for area residents. Aquatic life will continue to use the area which allows for more wildlife viewing.

9. The project had to be constructible in terms of work within existing City of League City ROW. The Preferred Alternative is located entirely within City of League City ROW and is constructible within the limits of ROW.

10. The project design needed to provide a solution that does not significantly increase the velocity, timing, and severity of flow and minimizes water quality concerns. The Preferred Alternative includes bioengineering techniques that will not significantly increase the velocity, timing, and severity of flow. This will also minimize water quality concerns as the vegetated channels will help filter sediment. Vegetation helps to dissipate stream flow and energy, protecting the surface from erosion.

Received 26 January 2022

11. The project had to consist of techniques proven to self-sustain and minimize maintenance when considering bank stabilization efforts. The Preferred Alternative includes bioengineering techniques that will be self-sustaining and will become more effective over time. The Preferred Alternative will also increase long-term channel stability, reduce long-term maintenance costs, and maintain flood control function of the channels.

12. The project had to provide increased safety to the area residents by reducing flooding risk. As demonstrated through the drainage modeling performed, the Preferred Alternative would reduce flooding risk which would increase safety to area residents.

13. The project had to avoid and minimize impacts to Waters of the U.S. The Preferred Alternative has been designed to avoid and minimize impacts to Waters of the U.S. while meeting the project's need and purpose. Upon project completion, areas currently classified as wetlands will function as streams, which are generally considered to be of higher quality than wetlands. Areas within Magnolia Creek and Cedar Gully observed to function as streams while performing the aquatic resources delineation will continue to function as streams upon project completion. The project is proposed to restore the function of the channels to their original design and provide enough capacity to accommodate the anticipated peak flows in the Magnolia Creek watershed. Natural stream design procedures are being incorporated into the design of the proposed project including but not limited to riffle and pool complexes. Significant adverse effects are not anticipated from the proposed project. Upon project completion as proposed, the new Magnolia Creek and Cedar Gully channels that will be impacted by the project will contain a total of 11,469 linear feet and 3.16 acres of perennial streams, instead of a mixture of perennial streams, intermittent streams, and emergent wetlands. Based on this information, the project would result in a net gain of linear feet and acreage of streams. It is generally understood that perennial streams are typically considered of higher quality than intermittent streams and wetlands.

It is generally understood that bioengineering techniques, such as what are proposed as part of the Preferred Alternative (Onsite Alternative 1), often cost less than structural techniques, are self-sustaining once established, and can become more effective with time. Therefore, construction cost should also be considered.

Although there is one onsite alternative that would have fewer impacts to aquatic resources, it is not practicable for those reasons displayed and discussed in Table 1, above. Given that an alternative needs to fail only one practicability factor to be eliminated from the process, Onsite Alternatives 2 through 4 would not qualify as the LEDPA. Given that the Preferred Alternative meets all of the siting criteria and practicability factors, and it avoids and minimized impacts to Waters of the U.S. to the maximum extent possible, it is the LEDPA.