Final Peer Review Report

For the District's

Recommended Minimum Flows for Horse Creek

AGREEMENT NUMBER: 23CN0004217
SOUTHWEST FLORIDA WATER MANAGEMENT DISTRICT
2379 BROAD STREET
BROOKSVILLE, FLORIDA 34604

NOVEMBER 2023

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1. INTRODUCTION

1.1. Background

The Southwest Florida River Water Management District (District or SWFWMD) is mandated by the Florida Statutes (F.S.) to establish minimum flows and levels (MFLs) for priority surface waters and aquifers within its boundaries for the purpose of protecting the water resources and ecology of the aquatic ecosystems from "significant harm" (F.S. §373.042, 1972 as amended). In this report, new minimum flows are proposed for Horse Creek, a tributary to the Peace River.

Under the statutes, a minimum flow for a given watercourse is defined as the limit at which further withdrawals would be significantly harmful to the water resources or ecology of the area.

The statutes require the District to annually develop and update a list of priority water bodies for which MFLs are to be established and identify those that will be subjected to a voluntarily independent scientific review.

The Florida Statutes also require that MFLs be established using the "best available information," for the MFLs "to reflect seasonal variations," and for the District's Governing Board, at its discretion, to provide for "the protection of non-consumptive uses." In addition, F.S. §373.0421 states that the District's Governing Board "shall consider changes and structural alterations to watersheds, surface waters and aquifers, and the effects such changes or alterations have had, and the constraints such changes or alterations have placed on the hydrology of the affected watershed, surface water, or aquifer…."

The State Water Resources Implementation Rule (specifically, Rule 62-40.473, Florida Administrative Code [F.A.C.] contains additional guidance for the establishment of MFLs, providing that "…consideration shall be given to the protection of water resources, natural seasonal fluctuations, in water flows or levels, and environmental values associated with coastal, estuarine, aquatic and wetlands ecology, including:

1. Recreation in and on the water;
2. Fish and wildlife habitats and the passage of fish;
3. Estuarine resources;
4. Transfer of detrital material;
5. Maintenance of freshwater storage and supply;
6. Aesthetic and scenic attributes;
7. Filtration and absorption of nutrients and other pollutants;
8. Sediment loads;
9. Water quality; and
10. Navigation.

1.2. Peer Review Panel

The District assembled a Peer Review Panel (Panel) consisting with expertise in hydrology, hydrogeology, water quality, statistics, modeling, fisheries, and riverine and wetland ecology. The District contracted with members of this independent panel of experts to provide a technical peer review of the proposed minimum flows for Horse Creek. The Panel brought a wide base of

expertise to the review that overlapped in some areas, while specific knowledge and experience that was also individually noted. The team is capable of conducting a thorough review. The Peer Review Panel includes:

- Harry Downing, M.S., P.E.; (Panel Chair): surface and groundwater modeling, statistical analysis, hydrology, flood risk assessment, MFL experience.

- Adam Munson, Ph.D., P.E.; Statistical modeling, ecological expertise, engineering experience, MFL experience.

- John Kiefer, Ph.D., P.E.; SrPWS: Restoration enhancement, and assessment of aquatic ecosystems, hydrogeology, MFL experience.

1.3. Overview of Horse Creek

The "Draft Recommended Minimum Flows for Horse Creek June 2023" report, along with appendices contains detailed information and evaluation processes used to establish the proposed minimum flows. The purpose of this section is to provide a general overview of the characteristics of the watershed and creek derived from various sources.

The Horse Creek watershed encompasses approximately 242.59 square miles (628 square kilometers). It extends from 1.55 miles northwest of the juncture of Hillsborough, Polk, Manatee, and Hardee Counties to the confluence of the Peace River in DeSoto County. It is one of several tributaries contributing flow to the Peace River (**Figure 1**). Fifty-six miles of Horse Creek conveys surface runoff to the Peace River. The United States Geological Survey (USGS) gage at SR 72 near Arcadia, FL has the longest-term flow record (1950 to present). Two other USGS stations with historical flow data are located upstream of the SR 72 gage, one of which (the Horse Creek near Myakka Head, FL gage) was used in the minimum flows analysis due to its longer period of record. The USGS Horse Creek at SR72 near Arcadia, FL gage has an average daily flow of 185 cfs with a range of 0 – 10,700 cfs. Daily flows at the Horse Creek near Myakka Head, FL gage have average 32 cfs since 1977, with a range of 0-2,240 cfs.

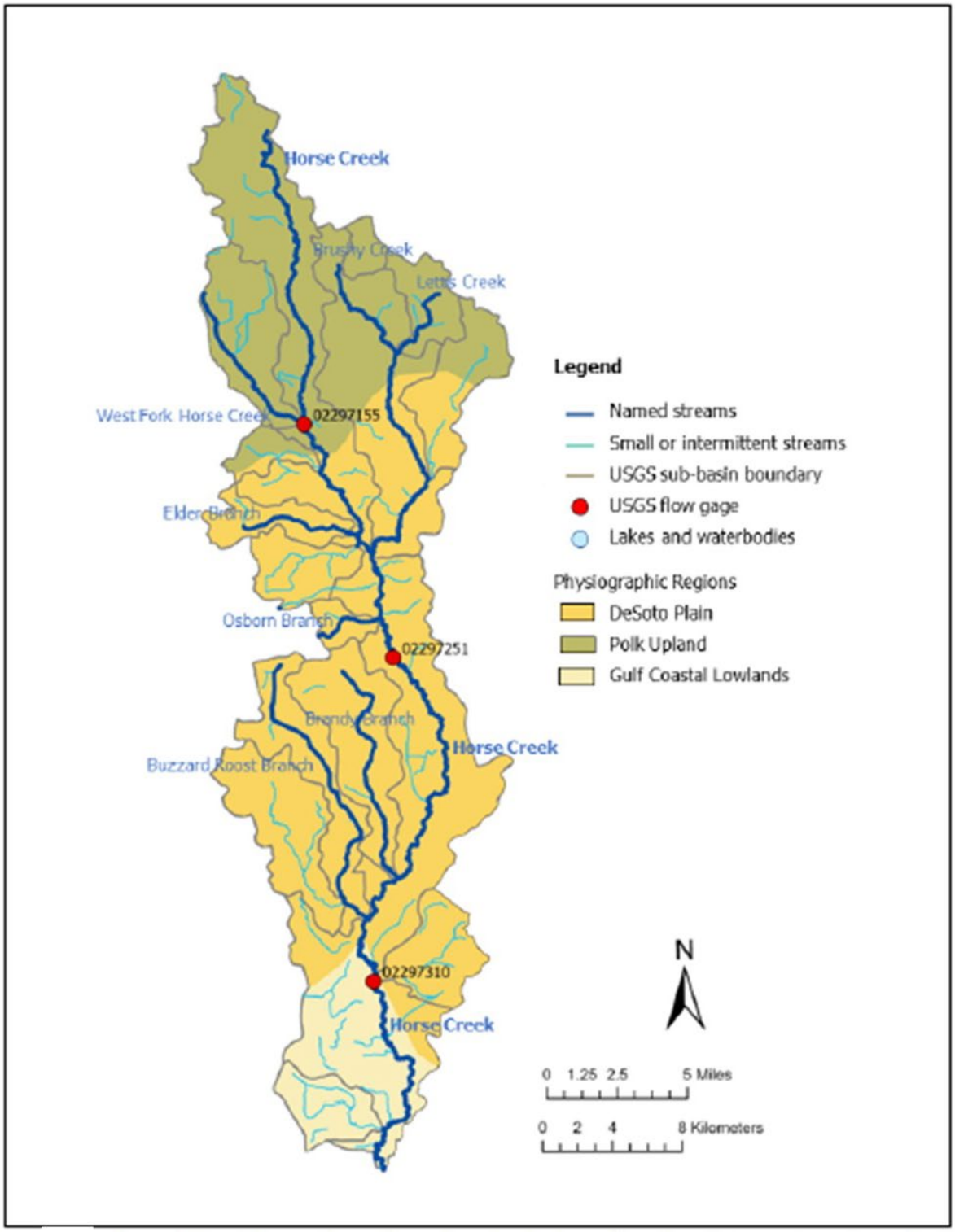


Figure 1: Map of the Horse Creek watershed showing the Horse Creek mainstem, named tributaries, smaller and intermittent streams. USGS drainage sub-basins, USGS gauge stations, and physiographic regions (Ghile et al., 2023).

Land surface elevations within the watershed range from 100-130 feet at the headwaters to 30-40 feet near the confluence with the Peace River. Due to confinement between the Surficial and Upper Florida Aquifers, the watershed exhibits relatively high runoff potential, which is also exhibited by the National Resource Conservation Service soil descriptions by the predominance of A/D and B/D soils. These soils are indicative of poorly drained soils exhibiting high water tables that have been drained. The United States Geological Survey National Hydrography Dataset identifies seven tributaries to Horse Creek: West Fork Horse Creek, Elder Branch, Brushy Creek, Lettis Creek, Osborn Branch, Brandy Branch, and Buzzard Roost Branch. Tributary abundance in the watershed defines an elaborate network of natural drainage systems that include palustrine, riverine, and some lacustrine habitats. This labyrinth of natural drainage systems suggests the significance of runoff within the watershed. This is in contrast to a karst area where natural drainage systems are limited.

Approximately 24.22% of the watershed classified as wetlands. For minimum flows development, the evaluation of hydroperiods supporting the wetlands along the Horse Creek corridor is of utmost importance, as is with consideration of instream habitats. As of 2020, about 12.24% of the watershed has been mined for phosphate. Other land cover classifications include: agricultural land (41.22% of the watershed), rangeland (9.2%), and upland forests (7.6%).

Several water quality constituents have been sampled by the Florida Department of Environmental Protection (DEP), Horse Creek Stewardship Program (HCSP), SWFWMD, and the USGS, with data collection spanning different periods between 1962 to 2018. In an exploratory water quality analysis by Applied Technology and Management and Janicki Environmental, Inc., constituents were grouped into broad classes including Nitrogen, Phosphorus, Chlorophyll, Physio-Chemical, Minerals and Metals, and Indicators of Water Clarity. Linear and logistic regression were used to evaluate water chemistry trends for determining background characteristics.

Some constituents have State water quality threshold limits established by the DEP, that have occasionally been exceeded over the period of record. In their report, the District summarized results from the most recently adopted Verified List (of impaired waterbodies), posted by the DEP on July 15, 2022. Currently no Total Maximum Daily Loads (TMDLs) or Basin Management Action Plans (BMAPS) have been developed or initiated within the Horse Creek watershed. There are three (3) National Pollutant Discharge Elimination System Permits for the watershed. No information was provided for these permits other than location.

To support minimum flow development, extensive sampling within a 36-mile corridor along Horse Creek was completed and additional information available for the study reach was considered. These efforts included HEC-RAS modeling, soils characterization, plant community assessments, evaluation of stream shoals, runs and pools and associated habitat availability; fish sampling, topographic surveying, and development of a digital elevation model (DEM).

HSW Engineering, Inc. conducted a study of the Horse Creek riparian corridor in 2012 to better describe the composition and distribution of plant communities and hydrologic indicators across six floodplain transects along Horse Creek. Tree, shrub, and ground cover assessments were conducted along the transects. Four wetland communities were identified along sampled transects: floodplain swamp, bottomland forest, hydric hammock, and a drier upland hammock

community. Within these areas, 16 tree species were identified and assigned importance values. The average terrain slope is 1.59 ft. per mile.

Soils along the floodplain cross-sections were evaluated for the presence of hydric or other flood indicators, as well as saturation and inundation condition. Key physical indicators of historical inundation were identified, including lichen or moss lines, trunk buttresses, and water marks, with lichen and moss lines being the most prevalent. These elevations were surveyed along transects to characterize conspicuous changes and heights of hydrologic indicators.

Fish sampling has been conducted along Horse Creek by the HCSP since 2003 and by the Florida Wildlife Commission (FWC) from 2010 to 2012. Only the lower portion of Horse Creek was sampled by the FWC. As of November 2020, over 67,500 fish have been documented by the HCSP in Horse Creek from 44 taxa, including 11 non-native species. The HCSP has suggested the proliferation of invasive species has contributed to the negative monotonic trend in taxa richness they have observed. Maintenance of fish habitat is a major component of MFL recommendations.

Palustrine and riverine habitats serve as valuable resources for natural communities. The description of existing flora and fauna and consideration of their habitat requirements is essential when establishing minimum flows. As noted in the District's minimum flows report, "Since 2003, the HCSP has collected macroinvertebrate data at four stations along Horse Creek up to three times a year, depending upon flow conditions. Sampling occurs within the following sampling windows: from March to April, from July to September, and from October to December. Samples are collected following the DEP protocols for Stream Condition Index (SCI), and habitat is characterized using DEP methods for Habitat Assessment (HA), Rapid Periphyton Survey, Linear Vegetative Survey, and Physical/Chemical Characterization (Flatwoods 2021). The SCI captures the capacity for flowing freshwater systems to support a balanced community, by classifying and quantifying benthic macroinvertebrates and identifying impairment relative to what may be expected with minimally disturbed conditions."

The District report also notes that "As of 2020, the HCSP had collected nearly 48,000 macroinvertebrates from Horse Creek, and categorized the individuals into more than 320 taxa. The twenty most abundant taxa groups, by HCSP taxa identification number. Of the 181 samples receiving SCI scores over the period of record, 35 were considered "impaired," with an SCI score of 34 or below. The majority (66%) of "impaired" samples were collected at station HCSW-2. The natural conditions of this station include low dissolved oxygen and low pH due to frequent low flow, an increased residence time compared to other stations in the creek, and the impact of runoff from a large upstream wetland. At other stations with "impaired" samples, bank erosion and habitat smothering contributed to a reduction in habitat availability and diversity. This effect was exacerbated at stations HCSW-3 and HCSW-4, which have larger drainage areas and higher flows compared to station HCSW-1. The majority (60%) of samples were considered "healthy." Florida Department of Environmental Protection (FDEP) has also collected macroinvertebrate information from 1993 to 2006."

1.4. Review Requirements and Overview

Beginning with document delivery on June 27, 2023, the Peer Review Panel was tasked to review the "Recommended Minimum Flows for Horse Creek Draft Report June 23, 2023" and all associated

appendices. Specifically, the Panel was tasked with reviewing all scientific and technical data, methodologies, and models used to establish the recommended minimum flows for Horse Creek. This included evaluating report conclusions, supporting data, all technical assumptions, and the procedures and analyses used.

1.4.1. **Conclusions:** The Panel was to determine whether the conclusion specified by the District concerning background information and effects of the recommended minimum flows are supported by the analyses presented in the report.

1.4.2. **Support Data:** The District relied on information from various public agencies and consultant studies. Numerous data sources were used to characterize the watershed and its response to various environmental changes to simulated withdrawals. Data were peer reviewed for collection procedures, adequacy, quality assurance and control. Some data are temporal, while other data involved field event collection. Some acquired data required certification, such as survey data. Other data requires sampling implementation methods and standards. The Panel was required to determine if the best available data were used.

1.4.3. **Technical Assumptions:** The determination of minimum flows is based on analysis methods that require technical assumptions. For Horse Creek, this included: block flow analysis, allowable wetland inundation assumptions, water quality, land cover effects, habitats, habitat responses, etc. The Panel was to review that assumptions are stated clearly, reasonable, and consistent with available information. Qualified data were reviewed for either elimination or limited use.

1.4.4. **Procedures and Analyses:** The District relied on multiple data sources: habit transects, elevation transects, historical flow data, water quality modeling, etc. to develop relationships and expectations in regards to minimum flow effects. The Panel was to determine if the procedures and analyses were appropriate and reasonable for determining the recommended minimum flows. The Panel was also to determine appropriate factors were applied, that nuisances encountered were adequately addressed, that procedural processes and definitions were sufficiently documented to ensure repeatability of the results, and that procedures and analyses were performed so that conclusions could be derived from the results. Conclusion will be reviewed by the Panel to ensure they are supported by input information and output information generated from the modeling.

The District's draft minimum flows report and appendices were discussed by the Panel in four Microsoft Teams teleconferences that were open to the public and facilitated by the District between July 24, 2023, and August 7, 2023. An initial Peer Review Panel report was delivered to the District on August 17, 2023. The District provided an updated minimum flows report and response document that addressed Panel suggestions on September 19, 2023. A final Panel teleconference (via Microsoft Teams) was held on September 25, 2023, to discuss the District's responses and report revisions. This meeting was also open to the public. All Panel communications occurred through use of a publicly accessible web forum, facilitated by the District. This final Peer Review Panel report summarizes the findings of the Panel.

2. Initial Review of Minimum Flows Report

2.1. General

This section contains suggestions included in the initial Peer Review Panel report to the District, delivered August 2023. The Panel found the District's draft minimum flows report to be well-organized. The minimum flows report includes applicable and pertinent data, appropriate numerical and statistical modeling, thorough analyses, and appropriate assumptions, along with reasonable conclusions. Caveats exist and are detailed below. Data and procedural enhancements have been recommended for future work. The Panel notes that findings from its final review of the District's proposed minimum flows for Horse Creek is included in the last chapter of this final peer review report.

2.1.1. **Supporting Data** as described in section 1.4 were reviewed regarding appropriate collection, accuracy, term of record, amount of record, applicability for baseline characterization and assumptions. Data for the watershed were collected according to acceptable standards and where standards were questioned clarification or additional supporting data has been requested. For example, Land cover classifications should be expanded to include more detail about extractive lands.

Six transects were collected along Horse Creek for determining the composition and distribution of plant communities, occurrence of hydric soils, and other hydrologic indicators. Elevation data were also collected in relation to these occurrences so that further analyses could be conducted by the District. Floodplain Swamp, Bottomland Forest, Hydric Hammock, and Upland Hammock were characterized. This information appeared sufficient by the panel (**Figure 2.1**).

Five sites were selected for collecting data for the System for Environmental Flow Analysis (SEFA) to provide the necessary channel habitat and hydraulic data to model potential changes in available suitable habitat for fish and invertebrates under flow reduction scenarios. Field data were collected during low, medium, and high flow ranges at pool, run, and shoal habitats at each site. For its initial review, the Panel requested that additional descriptions of these transect types be provided to help ensure repeatability for future efforts.

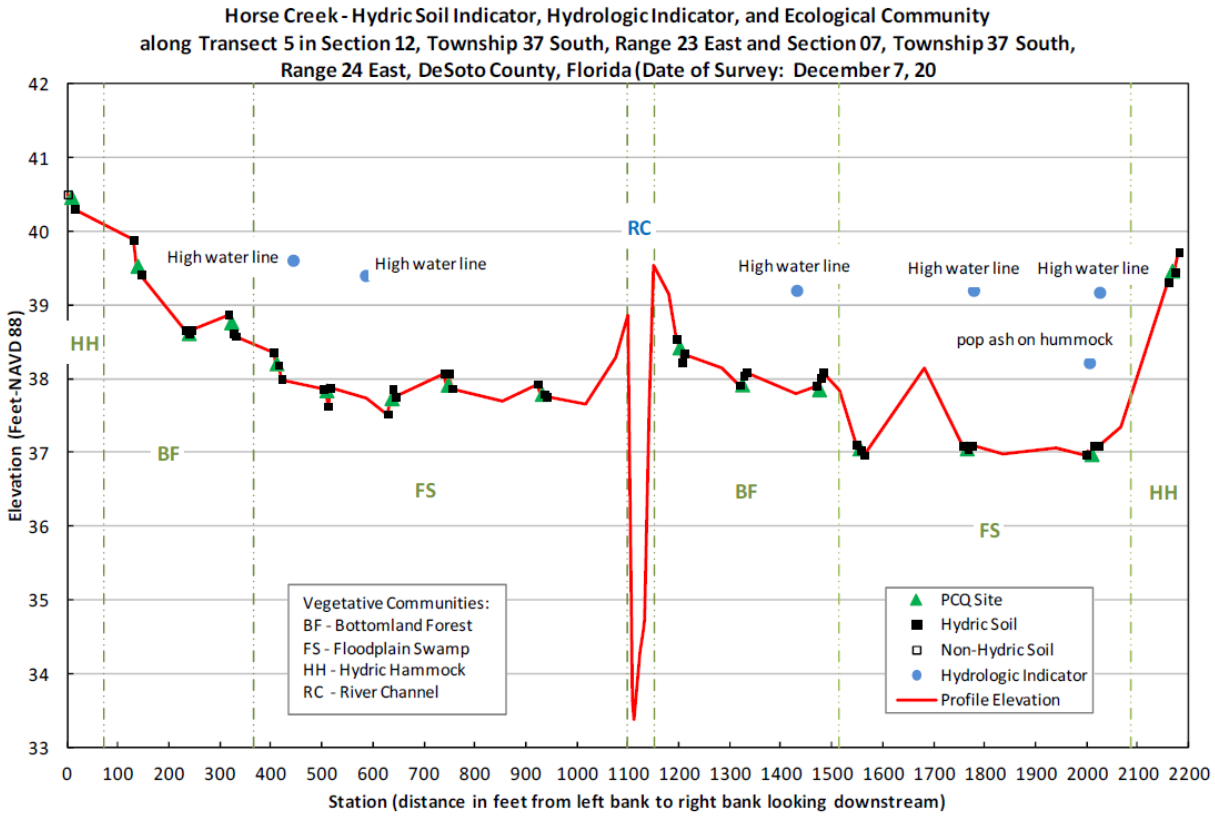


Figure 2.1: Elevation profile of soils, hydrologic indicators, and vegetation communities along Horse Creek transect 5, Reproduced from 2012 HSW Report.

2.1.2. **Technical Assumptions** were made by the District based on the information generated for the watershed and creek. Assumptions were made in District descriptions or determinations of anthropogenic impacts to flows primarily through withdrawals for public supply, mining and agricultural practices, instream creek habitat assessments, water quality considerations, and land cover descriptions for the overall watershed and stream corridors. In general, the technical assumptions were stated clearly and sound. As part of its initial review, the Panel recommended inclusion of additional information for finer resolution and description of information concerning land cover, soil, and wetlands.

Agricultural runoff is assumed to be a significant component of the determination of the recommended minimum flows. For Horse Creek it has been determined that agricultural irrigation increases runoff volume and needs to be accounted for in the stream analyses. Components in agriculture related runoff include: soil characterization, methods of irrigation used due to efficiencies, and site drainage systems. Hydrogeologic considerations are also important due to infiltration; and subsurface and surface drainage to receiving water bodies and conveyances. Hydrologic Soil Classification provides technical information regarding water table depths, specific yield, and vertical hydraulic conductivities. Based on its initial review, the Panel requested additional information regarding the soil types encountered. In addition, it was noted that surface roughness is another component affecting runoff.

Seasonal-flow blocks have historically been used by the District for the purpose of establishing minimum flows. The blocks were first discussed by Flannery in 2002 and they have been utilized by the District for most stream minimum flows since. These blocks are

based on typical seasonal variation of flows in streams in west central Florida and their use has been affirmed by peer reviews numerous times. The implementation of seasonal blocks is not without difficulty and is technically challenging. The District has recognized that seasonal transitions represent a statistical expectation and not an annual certainty. To better protect systems from low flows not aligned with seasonal expectations, the District has taken steps such as implementing a low-flow threshold without seasonal boundaries. More recently the District has suggested that flow-based blocks provide better protection to certain systems and first used this approach in the lower Peace River (Ghile et al. 2021) and is currently considering their use in the Little Manatee River (Holzwart et al. 2023). The document provides two instances from the lower Peace River report when flow-based blocks may be appropriate:

- Baseflow-dominated systems, for example, short, coastal rivers where discharge from spring vents accounts for much of the flow.
- In addition, flow-based blocks, which typically, but not always correspond with seasonal periods, may be appropriate for establishing minimum flows in some systems.

The Panel agrees that a flow-based blocks can provide better protection and believe the use of flow-based blocks has merit. However, section 2.5.2 of the report, where seasonal flows are discussed, describe the flows in Horse Creek as following the "seasonal pattern of rainfall in west-central Florida". No case is directly made that the system adheres to the cases described as appropriate for flow-based blocks. In their initial review comments, the Panel recommended that the report either make the specific case that Horse Creek belongs to one of the two categories above or make the generalized case that flow-based blocks offer better protection than season-based blocks and should be adopted in their stead.

The 15% Change Criteria has ample precedent as described in Section 1.3.5 of the report, but embodies an underlying assumption that harm is incremental when in some cases it is threshold based. In future work the Panel would like to see sensitivity testing of minimum flows determinations based on 15% change criteria versus threshold-oriented event-based approaches. Event approaches are particularly useful regarding the genesis and sustenance of alluvial and fluvial surfaces in river corridors; and regarding pulsed thresholds in hydrology for wetland community type sorting related to water depth, inundation frequency, and hydroperiod.

2.1.3. Procedures and Analyses were conducted to generate relationships and trends for specific indicator responses in support of minimum flows development. Several interrelated analyses were conducted using Hydrologic Engineering Center – River Analysis System (HEC-RAS) by the United States Army Corps of Engineers. The SEFA software was used to predict minimum flow effects on suitable instream habitat and other environmental habit characteristics were analyzed as well.

The 2005 Digital Elevation Model (DEM) was used in combination of land survey data for the generation of 93 HEC-RAS cross sections along a 36-mile stretch of Horse Creek. DEMs are

notoriously inaccurate in highly vegetated areas, however, numerous laser flashes can penetrate the canopies with sufficient returns. A review of the Light Detection and Ranging (LiDAR) raw data returns can provide additional detailed information. Information regarding DEM accuracy along the stream corridor was requested by the Panel in its initial review finding, through the review of the Survey Report associated with the DEM for quality control and assurance.

A single 1-D model option using HEC-RAS was performed to determine inundation depths and durations along the Horse Creek corridor. This option is appropriate provided there are no flow reversals and other dynamic effects occur in one direct; and flows on the rising and falling hydrograph limbs are not significantly different (hysteresis). Flow distribution, Manning's N values, and overbank contribution to flows are also important components of the modeling. Flows were apportioned based on gage data and additional site monitoring which is considered sufficient. Overbank conveyances and/or the lack thereof were determined by sensitivity analysis of elevation responses in calibrated and verified locations. Manning's N values were based on composite values due to meander and obstructions such as fences within the stream channel. The District made adjustment in the flow apportionment of the HEC-RAS model by INTERA 2018, by conducting linear regression analysis with the USGS gaging sites along with other flow adjustment factors. The Panel considers the HEC-RAS model adequate, but notes that it does not take into account dynamic flow conditions.

For future minimum flow analyses, the Panel suggests using HEC-RAS 2D as a means for reducing potential errors related to selection of inactive flow assignments and sensitivity to user inputs of Manning's N. HEC-RAS 2D is particularly valuable for systems like Horse Creek that have a tremendous range of floodplain morphologies and complex, rough valleys in places consisting of large in-line depressions, wide strands lacking a well-defined alluvial channel, multiple and branching alluvial channels, floodplain chutes, valley flats, and high sandy alluvial ridges. The floodplain/river channel flow exchanges often occur at specific junctions in low spots along the alluvial ridge lines that are rarely captured well using a 1D cross-section series.

The Peace River Integrated Model (PRIM-2, 2022) was used to estimate runoff by reducing groundwater pumpage and noting the changes in stream flow. The model has recently been peer reviewed and approved for use. The PRIM 2 model is a surface and ground water integrated model for the Peace River watershed. The results of the model were used in the minimum flows analysis in determining "historical watershed conditions" without groundwater pumpage. The 50% reduction in groundwater pumpage simulated was doubled to estimate water use effects (which could include agricultural irrigation) on Horse Creek flows. Modeling of Horse Creek indicates groundwater withdrawal contributes to an increase in stream flow. As a result, the estimated flow increases were subtracted from the historical flow record. Due to the hydrogeology of the area, there is little connection between the supply source for irrigation and other uses, and the surficial aquifer. Drawdowns in the groundwater are mitigated in the surficial aquifer due to the confining layers. As opposed to karst unconfined aquifer areas, where water use would have a negative effect on flows and levels due to aquifer depletion that is transmitted to the

surficial aquifer. The review Panel agrees that the PRIM 2 model is the best available for determining water use, estimated runoff addition due to irrigation and other uses.

Aspects of fluvial geomorphology are covered indirectly in some areas distributed throughout the report and its Appendices. This is a core discipline in river study that can unify an overall conceptual model relating watershed and aquifer characteristics in hydrology, sediment transport, and water quality to the variability of pattern, dimension, and hydroecology of the river channel and its floodplain. There should be a foundational effort to gain a preliminary understanding of the fluvial geomorphology of the system from its headwaters to base level to inform further field study and model development. That information can be used to assure all critical and unique habitat types and functional zones are studied and sustained along the valley.

The Panel would like to see minimum flows study design, conceptual model descriptions, and adaptive management strategies draw explicitly from this discipline in future minimum flow determinations. Chapter 2 of this report, Physical and Hydrologic Description, has sections on the watershed, land use and cover, soils, climate, streamflow, and hydrogeology. A fluvial geomorphology section could be added to that chapter.

A conceptual model could be provided that describes the essential underlying processes and relationships among the physical and hydrological conditions, water quality characteristics, and ecological resources described in Chapters 2, 3 and 4. It seems like something like this would fit well as a new Chapter 5, serving as a means to marshal the detailed system descriptions into a cohesive synopsis related to protecting processes as well as form. This chapter could also offer a preview of how the proposed minimum flows addresses the underlying processes as a nice setup for the subsequent chapters in the report describing the technical approach. The conceptual model could also be referenced and woven into how the environmental values are addressed in the narrative of Chapter 6, Section 5.

The concept should address the functional process zones (FPZ) found along the drainage network throughout the watershed and at the boundary of its downstream confluence. It should state which FPZs are included in the study area and why. For example, Horse Creek alternates among several FPZs including ephemeral headwater to nearly perennial mid-order stream positions with alternating high-energy and low-energy valley segments varying in their channel pattern and size, alluvial floodplain features, wetland types, and water quality with abrupt transitions from one FPZ to another. The study area encompasses the near-perennial FPZs only, does not extend to its confluence with the Peace River, and explicitly explored a subset of the FPZs within the study area leaving out most of the low-energy FPZs and some wetland types.

The conceptual model description should be synoptic where applicable. For example, more could have been synthesized and discussed regarding how the morphology of the studied sections and HEC-RAS model relate alluvial surfaces, floodplain soils, and floodplain vegetation to thresholds of water levels and flow volumes along the valley.

The proposed conceptual model development and new chapter is not required for this Horse Creek minimum flows study as the Panel finds the study to be sufficiently multiple in

its scientific disciplines and spatial scope, with some caveats described later. It appears that the study area was driven primarily by the position of the available long term gage records of the system, and the study locations were selected in part based on land-owner permission for access. That is a understandable use of the best available information, but it would be helpful to reviewers and interested parties to understand what was not included and why.

Floodplain vegetation communities, soils, and hydrologic indicators were sampled at six transects in the study area as described in Section 4.4 and Appendix C of the minimum flows report. At least two major floodplain community types are present in very wide and gradually sloped portions of the study area, and were not monitored or described (emergent marsh at Goose Prairie; bottomland forest strands upstream of Goose Prairie and at least one other downvalley location). At least two major aquatic communities were not described, also from within low gradient valley segments (paralentic ponds (Goose Pond); wide and deep paralotic channels (e.g. lagoons)).

These FPZs should be acknowledged, and reasons for focusing on the selected sites explained. For future minimum flows work, this is the kind of characterization that a preliminary fluvial geomorphic assessment will daylight and inform the sampling strategy. The panel examined whether the proposed minimum flows are protective of these communities using the HEC-RAS model results at the applicable model transects, and conclude that they are likely to be protected based on the approach taken in Blocks 3A and 3B. In the development of future minimum flows the Panel encourages the District to conduct transect study in each FPZ in the study area and to directly explore and describe the relationship between the flow percentiles (and percent of flow reductions) between the HEC-RAS model stages to the inundation of the specific surfaces and habitat types found at these transects.

The structure of the 4 Flow Blocks (**Figure 2.2**) is well-conceived and protective of all Water Resource Values. This is a progressive and robust assessment. Blocks 1 and 2 were protected by evaluating multiple specific habitats and functional features in each block and were set using the most protective metrics at the most-sensitive location among multiple positions in the study area. The approach taken there is specific, prudent, balanced, and highly intuitive toward addressing the key functions in those blocks.

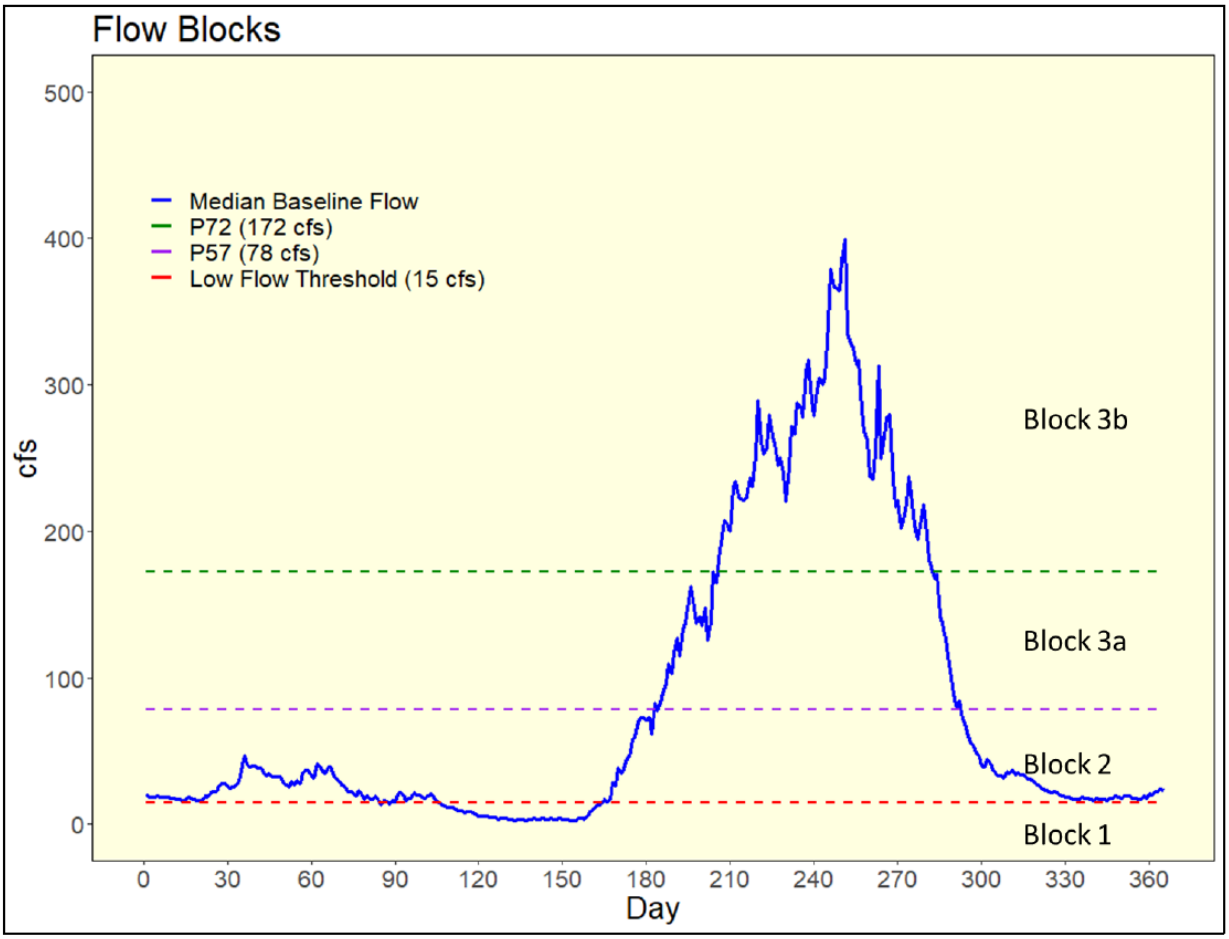


Figure 2.2 Flow Blocks superimposed on a hydrograph of median observed daily flow representing a typical calendar year. The horizontal lines represent Flow Block divisions.

Blocks 3A and 3B were derived primarily from a statistical analysis of the lower and upper portions of the floodplain area inundation, without directly addressing the requirements of specific habitats or processes in that part of the flow regime. Further, block-specific average percent of flow reductions were, respectively, recommended as the minimum flow for Blocks 3A and 3B. This results in a less protective approach versus using the highest flow in each block.

Block 3A includes the lowest-lying and most-deeply and frequently-wetted alluvial floodplain surfaces and communities that are wetted between the 56th and 72nd percentile flow. This block straddles bankfull flow. Bankfull flow is perhaps the single most important discharge for sustaining in-stream channel pattern and dimension, and its distribution of habitat substrates. It warrants specific attention and appears to be indirectly but sufficiently protected by this approach in this case.

Block 3B contains habitats that occupy elevations associated with 72nd to 99th percentile flow profiles. Substantial active alluvial surfaces occur above the average flow stages in that block and the uppermost alluvial substrates and associated biological communities may be unprotected at a 15% reduction of inundation area by using the PFR of the average flow in the block.

The Panel examined the results of the HEC-RAS model at the vegetation survey sections to confirm protection of each of the major floodplain habitats identified in the vegetation and soils study. The uppermost alluvial ridges (AR3) and their associated hydric hammocks (Max Bed2) occur between the 95 and 99 flow percentiles (**Figure 2.3**).

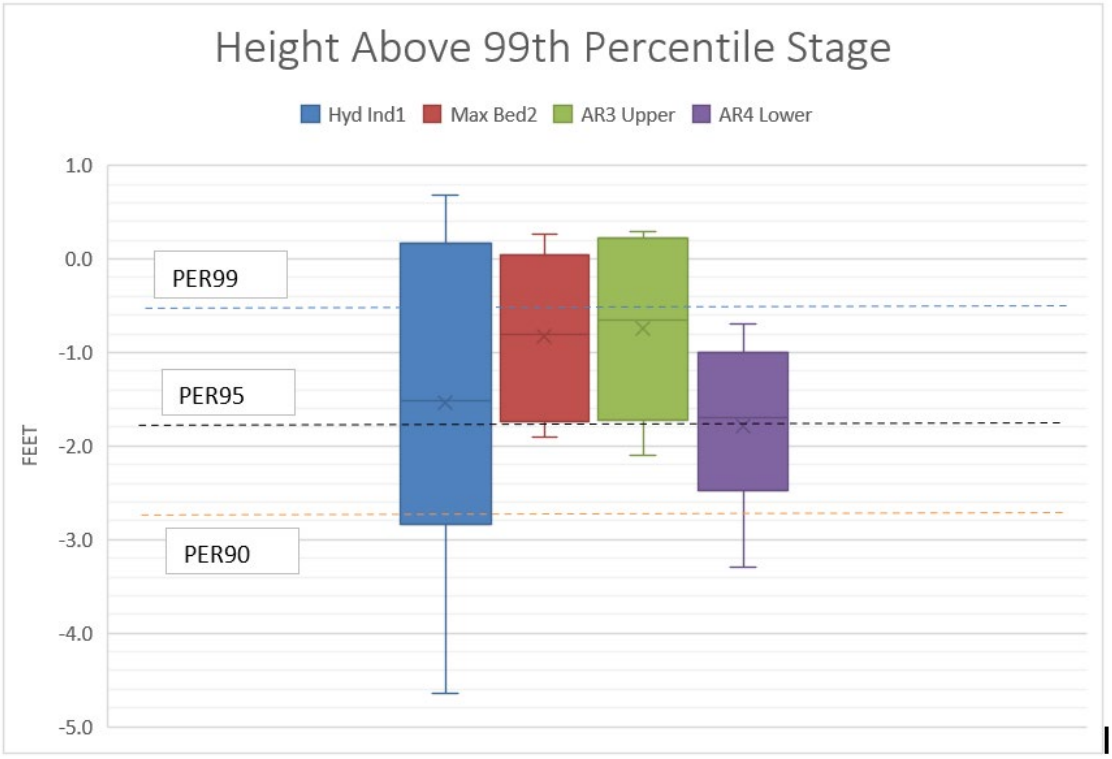


Figure 2.3: Floodplain Community Relative Elevations to Flow Percentile

The District is to be commended for the specificity and wide blanket cast to protect features in Blocks 1 and 2, building upon proven precedents and adding to the sophistication of previous analyses. The methods used for Blocks 3A and 3B are also well thought out for seeking a simple and elegant evaluation method drawing from modeling results, but are not as multiple and as habitat-specific as in the approaches used in the lower in-stream blocks.

There is greater uncertainty in this lack of multiple variables and spatial aggregation, and Block 3B has a considerable range of percent-of-flow reduction versus flow percentile across the flow range in the block.

For Block 3A, the Panel finds the narrow range of 14% to 13.5% percent-of-flow reduction does not warrant any further consideration as the result is insensitive to the method taken to select which percent of flow reduction to use within that range. However, Block 3B covers a range of approximately 13.7% to 7% flow reduction and more care is required in the selection of what part of this range is sufficiently protective of the surfaces and habitats spanning the associated flow range (**Figure 2.4**).

To provide greater assurance against significant harm to the upper-most habitats, the Panel would like the District to consider splitting the upper portion of that Block into a third floodplain block, Block 3C. A visual break is apparent somewhere near the 90 th to 92 nd flow percentiles. A break near that position would better center the allowable flow reduction for the upper alluvial surfaces and habitats in the floodplain without unnecessarily restricting withdrawals throughout the entire range of existing Block 3B.

The anticipated result would be mid-point floodplain inundation protections of the three main flood terraces in the system including the lowest alluvial surfaces such as the bankfull channel margins, lower backswamps, chutes, and deeper bottomlands (covered by existing Block 3A); middle terrace features including valley flats, lower alluvial ridges, and shallower backswamps (in the proposed reduced Block 3B); and the upper terrace's alluvial ridges and valley flats (in new Block 3C). Block 3C was added by the District to address this concern by the Panel.

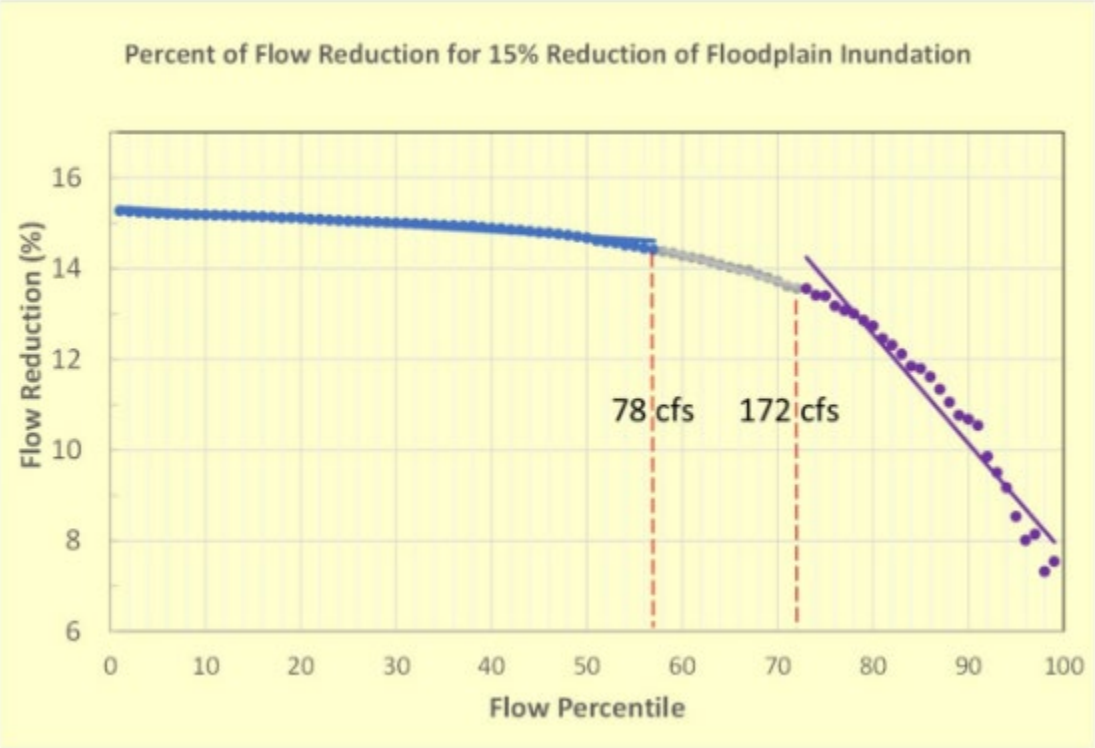


Figure 2.4: The sensitivity between the percent-of-flow reductions that would result in a 15% decrease in the amount of total inundated wetlands and river flow percentiles in Horse Creek. Note the fitting of the 3 lines for low, mid, and highflow percentile portions of the sensitivity curve.

Sediment transport calculations were discussed in Section 6.5.8 of the report. This study is a new approach to evaluate the sediment transport environmental value using results from the HEC-RAS model. This assessment compared annual average sediment transport calculations derived from the baseline and proposed minimum flow records. The assessment determined that a 12% reduction in sediment transport would occur if the maximum allowable withdrawals occur. This adds to the weight of evidence that the

multiple approaches taken to setting the minimum flows are also, in aggregate, protective of the sediment transport functions of the creek and its floodplain.

The report indicates a sediment transport calculation was made, citing use of the Enguland-Hansen equation. This equation was used to make at-a-station sediment-flow rating curves for multiple cross-sections and these calculated rating curves were used to generate a total bed material load transport mass for the flow period of record under baseline and recommended minimum flow scenarios.

However, the Panel does not believe the sediment transport output is realistic. It rivals that of much larger rivers, like the Kissimmee. An accurate transport calculation requires knowledge of actual loads and most transport calculations, as in hydrology modeling, require calibration to measured loads. The sediment rating curves were purely mathematical and based on incipient motion occurring at shear 0.006 lb./ft2. Natural southwest Florida stream corridors develop significant shear strength in their banks and floodplain that establish much higher thresholds of motion. Even the streambed sand grains can sort, settle, and develop a thin surface armoring of coarser fragments and non-sand material (shells, phosphatic pebble, and fossil gravel) and self-compaction that retard incipient motion. Some parts of the Horse Creek bed and banks have exposed limestone caprock. These factors mean that applying a motion threshold for sand will over-predict transport by a large margin. Plus, sediment transport equations are somewhat notoriously unreliable and an order of magnitude accuracy is often deemed the best available outcome.

Therefore, the Panel suggests the District describe the calculation as a transport capacity study. It is not intended as a representation of actual available loads subject to transport, but represents the capacity of the system to transport up to the calculated load should that ever be delivered from various sources as sand.

The report requires more description of why the Enguland-Hansen equation was used, versus other methods. Use of the equation is justified by the narrative, but alternatives were not discussed, leaving the question open as to whether this was the best-available resource. While this is great way to squeeze more value from a HEC-RAS setup, there are relatively simple and more accurate methods to calculate actual loads if that was the District's intention - for example using the Rosgen FLOWSED-POWERSED method. That technique requires only a single sediment transport field measurement at or near bankfull discharge for calibration and is typically more accurate than use of the available sediment transport equations in HEC-RAS.

The Panel is not recommending invoking an alternative method for the recommended minimum flows for Horse Creek, rather we are just providing some suggested considerations for future minimum flows. Another consideration is that some flow percentiles are more important than others for sediment distribution that maintains the pattern and dimension of instream habitat structure and floodplain surfaces and elevations. This includes bankfull flow, which is typically between the 70^{th} and 90^{th} percentile (on average 80^{th} percentile in nearly perennial peninsular Florida's nearly perennial blackwater creeks). Bankfull flow not only governs the equilibrium of the main open channel, it drives the meander forces and

thus grades the floodplain over time precluding it from simply rising above the streambed ad-infinitum. Bend migration is thus the mother of floodplain equilibrium.

Another important instream flow forms the inner berm channel. This is effectively a baseflow channel within the bankfull channel. It has its own meander pattern and habitat characteristics, and results from lateral bar formation. Its percentile association needs to be determined by field survey of the inner berm hydromorphology and HEC-RAS modeling, but a rough starting point might be the median flow (50^{th} percentile).

Each flood terrace or floodplain alluvial surface above bankfull flow warrants separate inspection, including from highest to lowest elevations: alluvial ridges and older scroll ridges, valley flat on upper alluvially-active terrace, valley flat on lower active terrace, linear backswamp, chutes (secondary flood channels in high energy floodplains), oxbow wetlands and ponds. A consideration for work on future minimum flows would be to synthesize a 2D HEC-RAS model, careful field diagnosis and survey of key alluvial features, and mapping of these features based on a digital elevation model (DEM) and HEC-RAS output at specific flow profiles associated with thresholds of specific alluvial feature wetting.

For the Horse Creek minimum flows, the District may wish to examine if the calculated transport volumes at the 50th, 80th, and 98th percentiles result in less than a 15% transport capacity reduction at each value, but this may be a big ask at this point and the aggregate transport capacity method used is progressive and adds a protective layer of study to the overall investigation, so this is not a keystone recommendation. For the development of future minimum flows, the Panel suggests careful targeting of the frequency and duration of channel forming and floodplain forming events tied directly to survey and hydraulic modeling as part of an event-based and multiple approach to sediment transport and deposition evaluations.

3. SUMMARY OF FINAL REVIEW FINDINGS

For their final review, the Peer Review Panel reviewed the updated report titled, " Recommended Minimum Flows for Horse Creek Draft Report, Sept. 18, 2023," associated appendices, and a tabular summary of the District's response to the Panel's initial review (included in the report Appendices). The updated District report and responses addressed the Panel's suggestions for corrections and clarifications in the procedures used in the evaluation of the proposed minimum flows for Horse Creek. The Panel found the report and associated analyses adequate for establishing the recommended minimum flows. The updated minimum flows report was approved by the Panel.

4. REFERENCED LITERATURE

1. Deak, K. 2023. Horse Creek Water Quality Analysis Using Generalized Linear Mixed Modeling. Technical Memo. Southwest Florida Water Management District, Revised August 2023.

2. Herrick, G. 2022. Horse Creek SEFA memo. Southwest Water Management District. Brooksville, Florida.

3. HSW Engineering, Inc. (HSW). 2012. Characterization of elevation, soils, and vegetation relationships in the riparian corridors of Horse and Charlie Creeks. Final Report. Prepared for the Southwest Florida Water Management District, Brooksville, Florida.

4. HSW Engineering, Inc. (HSW). 2021. Physical habitat modeling using System for Environmental Flows Analysis (SEFA). Final Report. Prepared for the Southwest Florida Water Management District. Brooksville, Florida.

5. Peace River Integrated Modeling Project 2 (PRIM 2) Draft Report, HydroGeologic, November 2022.

6. INTERA, Inc. 2018. Horse Creek HEC-RAS modeling and inundation mapping. Prepared for the Southwest Florida Water Management District. Brooksville, Florida.

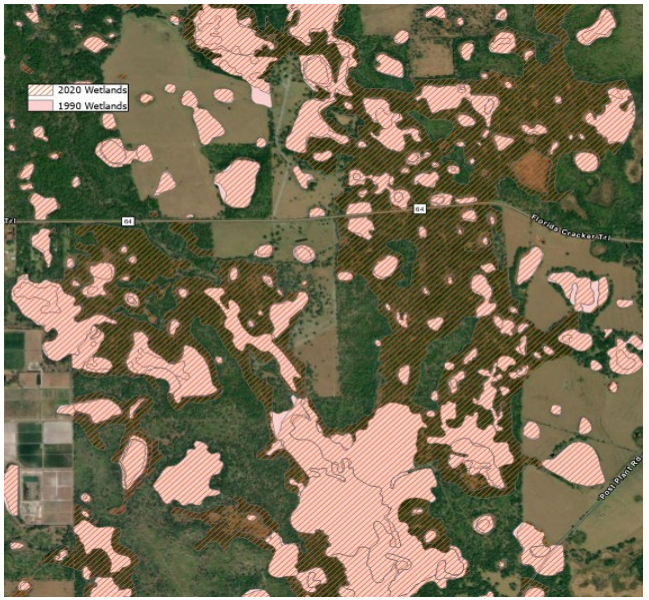
7. Janicki Environmental Inc. (JEI). 2019. Lower Peace River water quality study. Final Report. Prepared for Southwest Florida Water Management District. Brooksville, Florida.

8. SWFWMD, 2023, Revised September 18, 2023. Recommended Minimum Flows for Horse Creek Draft Report

Appendix
Spreadsheet of Specific Comments
For
Horse Creek

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
1	HD	Pg. 15, paragr-aph 1.3.7	Need more description regarding "Adaptive Management"	Suggestive Wording: "Could include regulatory requirements, site specific site mitigation, conservation acquisition, etc. if warranted."	Additional language was added to section 1.3.7. to explain how adaptive management will be applied to minimum flows for Horse Creek.	Yes
2	HD	Pg. 16, last paragr-aph	USGS description of flow monitoring sites assessment would be useful	Add USGS site description in terms of accuracy, flow record continuity, backwater effects, etc.	Added in Section 2.5.	Yes
3	HD	Pg. 19, paragr-aph 2.21	Mining shouldn't be listed under Urban	Add breakout for mining	See note under comment 6. To better describe mining activity in the Horse Creek watershed, two additional figures were provided. One figure shows all mine boundaries (including the planned DeSoto mine) in the watershed (Fig. 2-8) and another shows the locations of mining-related waste in the watershed, including the locations of clay settling areas (Fig. 2-10).	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
4	HD	Pg. 19, paragr-aph 2.21	Affects agricultural assessment of runoff interpretation due to management practices	Provide description of irrigation types	All existing water use permits for irrigated areas in the Horse Creek watershed (n = 113) were queried from the SWFWMD WMIS database during the week of August 21, 2023. The irrigation type listed for each permit was recorded. The majority of water use permits for irrigated areas (n = 92) included citrus, irrigated by low volume spray. The majority of fruit and vegetable crops (blueberries, tomatoes, melons, eggplants, and squash) were irrigated by drip with plastic. Commercial hay was primarily irrigated by seepage without plastic. Sod was irrigated by fully enclosed seepage (47%), seepage without plastic (27%) or other methods including low volume spray, center pivot, and sprinkling over plants. A brief description of this was included in the text of section 2.2.	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
5	HD	Pg. 20, 1st paragr-aph if reference to Figure 2-7 pg. 25	Appears mining has increase the wetland acreage in the watershed	Add discussion about the shift.	The difference in the amount of wetland acreage in the watershed throughout time is likely unrelated to mining activity, as there are pockets of expanded wetlands throughout the entire watershed. In comparing land use/cover classifications from 1990 to 2020, much of the gain in wetlands appears to be from previously isolated locations becoming connected as a larger polygon. The increase is therefore likely due to changes in methodology or technology used to develop these classifications over time. An example is shown: 	Yes
6	HD	Pg. 20, Table 2-1, and following Figures 2-3, 2-4	Mining should be included in the table	Add Extractive classification	Two subcategories within the Level 1 FLUCCS code for Urban/Built-Up lands were highlighted to better describe land use in the Horse Creek watershed as it relates to mining activity, Level 4 "Extractive" and "Reclaimed" categories. These extent of these lands were summarized in Table 2-1 and included in Figures 2-3, 2-4, and 2-7	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
7	HD	Pg. 26, Figure 2-8	Typo	"entirse" should be "entire"	Fixed.	Yes
8	HD	Pg. 30, paragr-aph 2.3	Description of Soils	Are they sands, loams, clays, etc.?	All SSURGO soils data compiled by the District was evaluated. The majority (89%) of soils were classified as either "fine sands" or "sands". An additional 3% of soils were classified as "muck," 4% were classified as soil complexes that were frequently flooded. Additional descriptive text was included in section 2.3. Soil characteristics were considered in PRIM2.	Yes
9	HD	Pg 33-34, Figures	Titles and Figures need to align	Format so that Titles and Figures align	Fixed.	Yes
10	HD	Pg 34, Figure 2-13	Rainfall Figure should probably be a bar graph	Convert to bar graph instead of continuous graph	Converted to bar graph.	Yes
11	HD	Pg.36, paragr-aph 2.5.1	Runoff inches compared to rainfall	Add runoff average compared to rainfall average	Runoff (inches) added to Figure 2-9.	Yes
12	HD	Pg 36, paragr-aph 2.5.1, and Figure 2-16 reference	Observed downward trend in flows	Add possible explanation of downward trend between 1950 and 1980	Explanations added.	Yes
13	HD	Pg. 38, paragr-aph 2.5.3	Does the NPDES permits cover a specific watershed area?	How much area for each, water use numbers were provided.	Additional details the mines associated with NPDES discharge and the types of waste permitted for release into Horse Creek were included in section 2.5.3.	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
14	HD	Pg. 40, paragr-aph 2.54 and Table 2-2	Affects conclusion about anthropogenic influences that may not be supported by the data or the possibly of a different interpretation	No significant changes could possibly indicate a stable land use conditions rather than lack of anthropogenic influences	Fixed.	Yes
15	HD	Pg. 43, second paragr-aph	Horizontal, vertical hydraulic conductivities widely varied, and also the specific yield. How do these values compare to the SSURGO database? PRIM 2 provides a table for the soils and associated properties.	Seems like the values provided are related to the interface between the SA, and the UFA for vertical conductivities while the horizontal represents horizontal fluxes to the creek or tributaries. Need to add verbiage to clarify.	The horizontal, vertical hydraulic conductivities and transmissivity are ranges for the surficial aquifers (not in the interface between SA and UFA). Text was added to clarify this point . Hydraulic conductivities were derived from SSURGO database but were slightly modified during calibration in some areas.	Yes
16	HD	Pg. 45-46, Fig 2-22 and Fig. 2-23	Need location of ROMP wells, appears that fluxes are different depending on location in watershed?	Add location maps	The location of ROMP 17 and ROMP 25 were added to Figure 2-2 and referenced in section 2.6.	Yes
17	HD	Pg. 58-59	Table Formatting	Correct Format for Title and Table	Fixed.	Yes
18	HD	Pg. 62-63	Table Formatting	Correct Format for Title and Table	Fixed.	Yes
19	HD	Pg. 78	Were DO's grab samples collected in early morning	DO goes up during the day, and is used up at night. Better indicator of COD or BOD when taken in the early morning hours.	DO grab samples were not always taken in the early morning.	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
20	HD	Pg. 80, paragr-	Narrative indicates agricultural soil amendments and pesticides reason for	Is this a correct assessment? Sulfate in	This is a good point. The conclusions from the previously cited Flatwoods report are still including in this text, but a brief	Yes
21	HD	Pg. 91	Mining and agriculture land use or groundwater use causing TDS increases	Highly mineralized water in this area of the state. Especially if drawn from the Avon Park formation, source of TDS?	The report previously described the increasing trend in TDS related to the runoff of irrigation, but clarifying text was added to indicate the source of this water is mineralized groundwater.	Yes
22	HD	Pg. 98	Mislabeling of Country Road	768 should be 769?	Fixed.	Yes
23	HD	Pg. 115-117	Fig. Title and Figure Formatting	Keep Titles and Fig. on same page	Fixed.	Yes
24	HD	Pg. 120, Table 5-1	Provide clarification	Add column which shows adjusted flows for MFL analysis for the average monthly	Added a column showing adjusted monthly flows.	Yes
25	HD	Pg. 119, verbiage concerning agriculture runoff estimates from pumpage	Need to know how much runoff is occurring compared to pumpage. Is this a conservative estimate of agriculture runoff due to groundwater.	Provide calculations that demonstrate runoff percentage to estimated water usage. This may support agricultural influence especially when compared to irrigation types	We do not see the need for such analysis for the following reasons: 1. Not all runoff flow directly into stream. For a pumping well located far away from streams, runoff from one cell could become evaporation or infiltration into the next cell, 2. the excess runoff from PRIM2 is not exclusively related to agricultural water use, it could also be related to water use for mining and public supply, and 3. along the boundary of the watershed there could be water transfer (water pumped out of the watershed applied in the watershed or vice versa).	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
26	HD	Pg. 132, 1st paragr-aph	Use of 2005, 5-foot DEM	Include survey report, and how DEM compares to survey data for the same area or point.	Included (Appendix G). The 2005 DEM was developed by 3001 Northrop Grumman company. During the QA/QC processing, the District found some consistent bias between the LiDAR data and the District's survey data. After the company corrected the biases, the District verified the vertical accuracy and accepted the dataset. As mentioned above (comment 25), INTERA also verified the DEM by comparing it against the surveyed points in Horse and Charlie Creek. A few DEMs containing erroneous data were identified and corrected in Horse Creek.	Yes
27	HD	Pg 42, Appendix "F"	Justification for Uniform Flow, 1-Dimensional, and Composite N value	Are fences across the creek, meander, and other items of significant effect for justification?	This report was prepared in 2018 and justification was provided for implementing a composite N value to account for tortuous cross-sections, bed irregularities and obstructions (wires and debris).	Yes
28	HD	Pg. 145, Table 5-5	What are the identifying characteristics of a pool, run, and shoal. Could not find in Appendices	Provide description of how the transect parts were identified.	Explanatory text and citation added to p. 148.	Yes
29	HD	Pg. 146, last paragr-aph of 5.4.4.3	Overbank definition at 78 cfs	How was this derived, answer explained on Pg. 161	Explanatory text added to section 5.4.4.3.	Yes
30	HD	Pg. 147, Table 5-6	No intercept in the regression, correlation is therefore redefined	Remove reference to correlation	Correlation coefficient removed.	Yes
31	HD	Pg. 167, Figure 1-6	Fig. should be referenced as 6-6	Re-number	Fixed.	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
32	HD	Pg. 175, paragr-aph 6.5.5	Should include ERP	Include ERP	Environmental resource permits were added to the description of District programs used to protect and maintain freshwater storage and supply in section 6.5.5.	Yes
33	HD	Pg. 176, paragr-aph 6.5.8	Sediment loads actual or potential, also what is the source? 1,169,222 tons/yr. seems unreasonable.	Suggest that the sediment loads are potential.	Fixed per Panel's recommendations.	Yes
34	AM	Whole	The report is well organized and well written. It is as consumable as such a technical document can be and coupled with the appendix is thorough and represents the districts continued methodological improvements and commitment to the MFL process.	N/A	N/A	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
35	AM	P. 11 & 12	The report notes that historically flow blocks have been calendar based (Discussion on page 122). The District then cites Ghile 2021 as introducing flow based blocks for the lower Peace River and Shell Creek. We have discussed horizontal vs vertical blocking for along time. In fact I would summarize the creation of the LFT as having emerged from concern over the adequacy of the vertical blocking. I think the argument for horizontal blocking is strong and I commend the district for setting aside the normal blocks on the Lower Peace River. But I think the very brief discussion in this report is shy of making the case for Horse Creek that was made for the Lower Peace. The Lower Peace river report says the following " For some baseflow-dominated systems, for example, short, coastal rivers where discharge from spring vents accounts for much of the flow, use of a seasonal, building-block approach may not be necessary." In addition, association of blocks with specific flow-ranges, which typically, but not always correspond with seasonal periods,	Explain why the vertical block are appropriate under the condition cited in the Peace River report or make the general case that all rivers should use the horizontal block.	The Lower Peace river report and most other District MFL reports discuss the utility of flow blocks for minimum flow development, in particular for runoff-dominated systems. However, for the Lower Peace River, flows between the 75% and 50% exceedance flows were insufficient for representing the seasonal, medium flow, block 2 during the 2007-2014 simulation period used for minimum flow analyses. This occurred due to the preponderance of out-of-season flows during block 2 in the simulated years. As a result, for the first time, the District initiated the use of flow-based blocks rather than fixed-date (seasonal) blocks for minimum flow development. For this same reason, the District has decided to use flow-based blocks rather than fixed-date blocks for its current minimum flow analyses. To better clarify use of this approach for Horse Creek and Charlie Creek, the second paragraph in Section 5.2 of the MFLs report for each creek has been modified as follows: “To help reduce unintended negative impacts on biological communities in years where flows are not well-matched to the fixed start and end dates of the calendar-based blocks, flow-based blocks were recently introduced by the District for runoff-dominated systems. Flow-based blocks were used for the reevaluation of the Lower Peace River minimum flows and development of minimum flows for Lower Shell Creek (Ghile et al. 2021), as well as for development of proposed minimum flows for the Little Manatee River (Holzwart et al. 2023).”	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
			may be appropriate for establishing minimum flows for some systems." The Peace River Report went on to show that seasonal block two was not corresponding with flows over the 75%. I agree with the statements from the Lower Peace River Report. The application of the horizontal flow blocks to the Horse Creek is probably very reasonable. However, I feel the report has not made the case directly for the change the same was the Lower Peace report did. Further I am not certain the Peace River Report made the case for all rivers. So citing the lower Peace report feels insufficient since in my quick review of the lower Peace report I did not find the statement that would generalize the use of horizontal flow blocks to Horse Creek. Since it is not a short coastal river with many spring vents accounting for much of the flow I assume it is supported under the second condition in the Peace report where the flow blocks do not always correspond with the seasonal period. Please note I like the horizontal blocking and think it is reasonable.			

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
36	AM	P. 15	The claim of adaptive management in MFL documents is routine in most Districts. Further, the District's commitment to continued monitoring, learning, and re-evaluation (adaption) is evident in its actions. The Horse Creek Report defines adaptive management as a " systematic, iterative approach to meeting management objectives in the face of uncertainty through continued monitoring and refinement of management actions based on consideration of alternatives and stakeholder input (Herrick et al. 2019)." . The citation is from the Districts Homosassa river re-evaluation when it says exactly the same. This citation leaves the reader feeling the approach is better defined in the original source, though the original source is similarly vague (though both cite Williams). The District certainly does these things but I believe the documents would be improved by an expanded description.	The report would benefit from additional discussion.	Additional language was added to section 1.3.7. to explain how adaptive management will be applied to minimum flows for Horse Creek.	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
37	AM	P.20	The reclamation of mining land that is complete, in-process, or future is only 83.4% in total which seems to leave a lot unaccounted for. "As of 2019, approximately 18% of the mandatory phosphate mined areas had been reclaimed, 9.4% were in progress, and 56% were designated as future work (Figure 2-9)."	Explained that this is the best info available or a time lapse between reports etc. The missing seems a lot so just a sentence explanation would help.	The remainder of the lands here were classified as "non-disturbed" in the GIS layer used to generate the figure and statistics. To more intuitively describe the reclamation status of land in the watershed, the text was revised to discuss the status of only disturbed land: "As of 2019, approximately 22% of the disturbed mandatory phosphate mined areas had been reclaimed, 11% were in progress, and 67% were designated as future work."	Yes
38	AM	P. 35	I can see Figure 2-14 and 2-15 are similar and made at the same time. But the bar graph and the smoothed solid work because of the AMOs smoothness and the fact that you can always see the movement between the bars. But 2-25 the "Flow" obscures the "Nino". It's hardly critical but line graphs would better depict this and allow the reader to better approximate how well the correlate over time.	consider a line graph.	Converted to line graph.	Yes
39	AM	P. 37	Above you conclude that horizontal blocks should be used rather than seasonal…But here you conclude "The typical seasonal distribution of flows in Horse Creek follows the seasonal pattern of rainfall in west-central Florida, with high flows occurring during a four-month wet season".	Just make that case for horizontal blocks or state clearly above why.	In general terms, the horizontal (i.e., flow-based) and vertical (i.e., seasonal or calendar-based) block methods both account for seasonal patterns of rainfall and flow distributions. However, the flow-based block method better accounts for out-of-season flows for minimum flows development and implementation, i.e., it better addresses sensitivity of flow-related environmental factors regardless of inter or intra-annual flow variation.	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
40	AM	P. 40	The Report states that the trend analysis suggested that anthropogenic influences on flows in the creek are not significant (1995-2018). The report follows that with supporting evidence (Intera 2018). It then reverts to an older analysis (PBSJ 2007, which used data from 1940-1999). It seems odd to present two recent studies saying no impact and then go to an older one to show there might be some impact in during the two lowest flow months if one look carefully from 1950-1969 and than from 70-95 and then post 95. At a quick glance at these times roughly align with the switches in figure 2-14 (AMO/Flows). Further I am not fully convinced Charlie is an unimpacted base line. What I come away with is that no trend was found in recent reports but there is concern that Agriculture might be altering the lowest flows. I think the PRIM2 model also suggest that but something in this section just feels like it is at odds with itself.		Fixed. The Charlie Creek flows are impacted but no significant trends indicate a stable land use conditions rather than lack of anthropogenic influences. Figure 2-15 only shows the runoff how Charlie Creek flows have relatively been stable when compared to Horse Creek.	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
41	AM	P. 56	Since you note in a single sentence that both the Linear and Logistic regressions use R^2 to quantify variation and export R^2s later you should probably note here in a single sentence that the R^2 for the Logistics was a generalized R^2 and was rescaled for interpretability so the reader does not wonder what was reported.	Add a little detail to the report here. Just a sentence or two.	The original paragraph that briefly described the use of R^2 values for linear and logistic regression analysis was removed and replaced with clarifying text.	Yes
42	AM	P.119	The baseline reconstruction take the difference in monthly averages from the 0% and 50% pumping reduction runs from PRIM2 and double it. Makes since if you expect a linear response. A 25% reduction was run but is barely mentioned. Can the case be made that the reduction from 50-100% is expected to be the same as the reductions from 0-50%...Was the 0, 25, 50 linear?	Add some language explaining why this is reasonable.	A paragraph was added to the report. The streamflow response to pumping reductions of 0%, 25%, and 50% predicted with the PRIM model was linear. For Lower Peace River we created a linear regression using three points and generated daily flows for a zero-pumping scenario. For the Horse and Charlie Creek analyses, we decided to double the 50% pumping impact to avoid the uncertainty associated with regression equations developed from only 3 points.	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
43	AM	P. 113	Two times the modeled reduction is subtracted from each month. So for instance 5.82 cfs reduction in June is subtracted from all Junes all the way back to 1950. But the PRIM is for 2003 to 2018. And the case is often made that a lot (other than mining) is stable in the watershed. But most of the land use codes and maps go back to about 1980. Can you throw in a quick citation or reminder here where you evidence that withdrawals in 1950 are about that same as now?	Justify more directly the doubling of the modeled increase and the application of the modeled change undiluted back to 1950. (The model is clearly the best tool you have to evaluate the effect).	We added the assumption of the same impact over period of record as one source of uncertainty for the baseline flow development. We don't have measured pumpage that goes back to the 1950s. However, based on some estimated groundwater use for the SWUCA , pumping started to significantly increase in 1960s and peaked and stabilized in 1970 through 2010. After 2010 it started to gradually decrease because of reduced pumping and water conservation measures. To assess the sensitivity of the proposed minimum flows to this issue, we developed a new baseline flow scenario with no impact to the pre-1960s period. The MFLs analysis results showed no change for both systems.	Yes
44	AM	P. 160-163	This was interesting. What the District did is reasonable in trying to maximize the total R^2 in an attempt to pick the three best linear segments. An alternative to consider would be maximizing the minimum R^2. A Max-Min formulation (commonly used in multiple objective optimization) would assure that your worst fit was as good as possible rather than maximizing the total (perhaps to the detriment of one). It might be appropriate here to provide proportional protection to all blocks since you use this to for defining 3a and 3b.	Consider a max-min formulation in the future if not this time.	A min-max formulation will be considered for future MFLs.	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
45	AM	P. 177	The inclusion of the sediment transport WRV is laudable and improves the argument that the MFLs is protective of the Sediment transport WRV. Please clean up the language a little to be certain that it is clear this is transport potential and has not been demonstrated to be actual transport.	Improve text.	Fixed per the Panel's recommendations.	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
46	AM	P. 178	The extension of the water chemistry to include mixed effect models is commendable and demonstrates the Districts commitment to continuous improvements in it's analysis. I believe this is an excellent and explainable procedure for this application because independence can often not be satisfied in environment data but also because they are a good choice for unbalanced data sets. McElreath (2020) argues that '[…] multilevel regression deserves to be the default form of regression. Papers that do not use multilevel models should have to justify not using a multilevel approach' (p. 15). (McElreath, R. Statistical rethinking: a Bayesian course with example in R and Stan. In Chapman & Hall/CRC Texts in Statistical Science Series, xvii, CRC Press, Boca Raton, FL. P. 469 Google Scholar Link. That said there are a lot of tools available for classification.	N/A	The District notes and appreciates your comment.	Yes

Comment No.	Peer Reviewer	Location in Initial Report	Reviewer's Comments	Reviewer's Recommended Action	District Response	Panel Accept Response (Yes/No)
47	AM	P. 178	When you preform classification the cutoff for an outcome is typically prescribed by the user. Most programs default to a .50 but that threshold seldom is the best choice. I do not have a suggested value for you but consider your confusion matrix and generate sensitivities and specificity at varying cutoff levels and pick one which make sense. Perhaps it is .5 but the choice should be discussed and not left as the software default. The .5 is a good choice if the two errors are cost symmetric...which they might be considered if cost are unknown.	Addition discussion would benefit the reader and perhaps future MFL reports.	The 0.5 probability threshold was selected based on its common use as a standard, its previous application for a similar analysis by Janicki Environmental, Inc. on water quality constituents in the Chassahowitzka River, and due to lack of rationale for an alternative threshold. A clarifying sentence was added to the text in section 6.5.9 to explain this.	Yes
48	AM	P. 126	The District used the most restrictive cross section to develop the fish passage standard for the LFT. But this sentence seems misleading. "The mean of these flows at the gage site was calculated for use as a fish passage metric to be considered for development of the low flow threshold." <- last sentence of second full paragraph on the page.	Consider re-wording	The sentence was re-worded.	Yes

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49	AM	Appendix G	Please clarify why you chose of four three month treatments. According to the text there are three seasonal blocks of varying length. Using those dates or approximate months would be consistent with the seasons identified in the text. Further, since the flow seasons would more likely correlate to agriculture usage they might provide more insight than four 3-month blocks.	Expand discussion	The blocks referenced in the text refer to seasonal flow patterns, with highest flows occurring in mid-June through October and low to medium flow occurring during the remainder of the year. Flows are already considered in the GLMMs. The three-month divisions (Jan-Mar, Apr-Jun, Jul-Sep, Oct-Dec) were intended to capture other seasonal changes that may impact water quality directly or indirectly, including things like changes in photic period and intensity, biological activity, and evapotranspiration rates that can occur during traditional quarters of the year. Precedent for including four 3-month blocks was established in the analysis performed by Janicki Environmental, Inc. on the Chassahowitzka River water quality analysis. The inclusion of additional parameters or changing the definition of "season" in this work may be considered in future work. A sentence clarifying the intent of the seasonal term was added to the appendix.	Yes
50	AM	P. 167	Figure labeled 1-6	Correct Figure number	Corrected.	Yes

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51	JK	Yes	The percentage of SCI scores in the Impaired and Healthy categories are mentioned, but not the percentage of Exceptional. I read this section and come away thinking one of the best streams in SW FL for aquatic fauna biointegrity has poor benthos. As mentioned, much of that impression stems from a single station that has a wetland fauna being assessed as a lotic fauna.	Add narrative regarding the % Exceptional. The natural wetland-influenced conditions at monitoring station HCSW-2 reinforce the benefits of developing and describing a conceptual model for the system as an iterative exercise to inform a field monitoring and modeling strategy specific to the functional process zones along the valley in future MFLs.	The text was modified to highlight the % Exceptional and to indicate that 81% of samples collected throughout the watershed were indicative of either "Healthy" or "Exceptional" conditions.	Yes
52	JK	Yes	Section title is out of order (4.3 Ecological…)	Change 4.3 Ecological… to 4.5 Ecological	Fixed.	Yes

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53	JK	No	PRIM2 daily flow correlations were strong (R2 = 0.82) for Horse Creek at Arcadia. Monthly average values were used to determine the effects of groundwater pumping, then adjustments made to the daily flow record by multiplying the monthly average percent differences by 2. No discussion of what error this may induce in the baseline flow record.	Discuss the likely amount of uncertainty in the baseline flow adjustments, at least in generic terms. This is one of several sources of uncertainty in a chain of calculations and measurements used to establish MFLs in all Blocks with potential interest regarding Block 3A and 3B protections which each relied on a single metric (flood area inundation) aggregated spatially along the entire study area. In contrast, Blocks 1 and 2 were protected by a more layered assessment of multiple metrics examined at multiple positions in the study area with the most sensitive metric at the most-sensitive position used to	On Page 129, sources of uncertainty associated with PRIM2 model were added. For the floodplain inundation assessment, B3c was introduced at 93rd percentile to provide more protection for upland floodplain habitats. In future minimum flow analyses, floodplain analysis by wetland types and at multiple locations will be considered.	Yes

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				establish the MFL. This 'bundle of sticks' approach is conceivably less sensitive to cumulative measurement and modeling errors versus use of an 'eggs-in-one-basket' assessment that is spatially-aggregated single-variable. Additional comments regarding how to address uncertainty in Blocks 3A and 3B are provided elsewhere in my review.		

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54	JK	Yes	Flow blocks and other matters are often depicted over the daily median flow hydrograph for the period of record. And this kind of hydrograph is used to compare measured, baseline, and MFL flows.	Use of median daily values suppresses visualization of flow extremes in the record, and the range-of-variability drives some important functions. I suggest also including flow duration curves based on the full range of daily average flows in the record for this report, with the flow blocks and flow volumes used to establish each allowable reduction in the block (example attached for Charlie Creek under Worksheet 'Charlie Creek' on MS Excel file 'FDC-Horse&Charlie Creek JHK'). Also, for future MFLs consider developing an Appendix using SWIDS.	A flow duration curve is used in Chapter 5, Section 5.2. In addition, a flow duration curve with recommended minimum flows for all blocks is added in Chapter Section 6.4. The District is aware of the use of wetland-based Surface Water Inundation Signatures (SWIDS) for minimum flows devlepment within Florida and will continue to consider their potential utility for future minmum flow determinations.	Yes