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Technical Memorandum

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Purpose

Recent federal regulatory changes relevant to §404 of the Clean Water Act have the potential to significantly affect stream ecosystems and mitigation markets in the state of Texas. Specifically, the issuance of the Navigable Waters Protection Rule (which categorically excludes ephemeral streams from federal jurisdiction) and the recently proposed reissuance of Nationwide Permits, both have environmental and mitigation demand implications within the Fort Worth (SWF) and Galveston (SWG) Districts of the U.S. Army Corps of Engineers (USACE). The USACE §404 permit record was analyzed to quantify the potential effect of the proposed replacement of a key regulatory threshold for stream impacts—0.1acre for 300 linear feet (LF).

Methods

In the SWF and SWG Districts, since the 2008 Compensatory Mitigation Rule, the ORM database has, in general, contained linear feet (length) and, sometimes, acreage (areal) measurements for stream impacts. In this analysis, we sought to quantify how impacts greater than 300 linear feet (which are currently regulated) will be affected by proposed NWP rule changes that would relax regulations on impacts measured <0.1 acre.

We selected all stream impacts (n=*1605 permits*) from a dataset of all NWP permits for the SWF and SWG Districts of the USACE. These data were obtained via FOIA request to the USACE and cover the years 2014 to 2019. Many permits contained multiple database records, indicating multiple impacts for a given permit (although these were mapped in ORM at the same point in space).

We selected four subgroups of permit records.[1] First, we used the R statistical software platform [v3.6.2] to select all permits for stream impacts that 1) contained complete records of linear feet and acreage measurements and 2) were > 300 linear feet and < 0.1 acres (*n= 103 permits*). These records indicate permits that will be clearly affected by new NWP rule changes.

[1] All other permits were left out of this analysis (*n=1414; 88.1%*).

Unfortunately, a large number of records are missing linear feet measurements while impacting < 0.1 acres (n= 481 permits; 30.0% of permits impacting streams). As a result, there are numerous, additional impacts that may be affected by proposed rule changes.

Therefore, for our second subgroup, we selected permits where the total impact area (across records within a permit) summed to < 0.1 acre, and there was partially missing information for linear feet. In this case, we attempted to determine if there was a stable, linear relationship for the records containing both linear feet and acreage. If there was a stable relationship (*n=13 permits*), we extrapolated this to estimate the total linear feet of impacts within the permit.

For our final two subgroups, we selected permits that had no information on acreage (and with impacts > 300 linear feet). For these permits, we attempted to convert the linear feet measurement to an area measurement (acres).

How can we determine the area of a stream impact using only the stream's length? While we need to have additional data, ideally the stream's width – this information can be difficult and laborious to collect. For example, Pavelsky and Smith (2008) introduced a technique for using aerial imagery to estimate river widths, and Allen and Pavelsky (2018) combined this technique with machine learning approaches to derive river widths for major rivers around the world. While, resources and time were not available to employ this technique, we instead were able to draw on assumptions about the width of streams based on their position in the broader hydrological network (described more below).

For our third group of permits[2] (*n=15 permits*) – those impacting >300 linear feet of perennial streams and with no acreage information – we used QGIS [v3.10.6] to snap (i.e., spatially shift) the point locations of permits to the closest stream flowlines from the National Hydrography Dataset Plus (NHDPlus; USGS 2020), which include a calculated Strahler stream order[3] and a variety of other attributes. Permit points were kept if they were < 1000 meters from the stream lines *(n = 15 permits*). A buffer of half the width of the permit's impact was placed around each snapped point, capturing the length of the entire stream impact around the snapped point. The Strahler stream order and length of each respective segment were joined to permit data and exported to R.

Work by Downing et al. (2012) have attempted to link stream order and stream width, using ground-truthed data. They highlighted a sub-set of this ground-truthing effort that was focused on US streams, which are narrower than the world average, especially in the arid western US. We extrapolated the relationship between their global and US stream width estimates to higher order streams (see Table 2), and multiplied the length of each stream segment (feet) by the width (feet) associated with each segment's stream order and converted into acreage.

Finally, in our fourth subset, we selected permits (*n = 90 permits*) with no information on acreage and with impacts > 300 linear feet that impacted ephemeral, intermittent, other Cowardin classes, or a combination of classes. As the stream flowlines from the NHDPlus represent perennial streams and fail to account for ephemeral completely and often intermittent streams, we calculated we assumed that ephemeral streams were approximately 1 ft wide, intermittent streams 2.8 ft wide, and other stream types were 2.8 ft wide (i.e., same as Downing et al.'s [2012] estimates of first order perennial stream width).

[2] For our GIS analysis, if a permit contained multiple records, all impact lengths were summed to create a single record.

[3] Our data included up to sixth order streams (Strahler).

Table 1. Estimates of stream width, We extrapolated higher order stream width estimates for US streams using the first order relationship to Downing et al's. (2012) ground truthed width as a guide (1.9m/0.85m = 0.447 multiplier).

	Downing et al. (2012) (ground-truthed width) (ft)	Downing et al. (2012) (USA width) (ft)	Non-perennial stream estimates
Ephemeral			1 (0.3 m)
Intermittent			2.79 (0.85 m)
Other-Cowardan			2.79 (0.85 m)
1st order	6.23 (1.9 m)	2.79 (0.85 m)	2.79 (0.85 m)
2nd order	8.53 (2.6 m)	3.94 (1.2 m) [estimated]	3.94 (1.2 m)
3rd order	24.60 (7.5 m)	11.15 (3.4 m) [estimated]	11.15 (3.4 m)
4th order	90.20 (27.5 m)	40.36 (12.3 m) [estimated]	40.36 (12.3 m)
5th order	238.46 (72.7 m)	106.63 (32.5 m) [estimated]	106.63 (32.5 m)
6th order	636.976 (194.2 m)	285.12 (86.9 m) [estimated]	285.12 (86.9 m)
7th order	803.60 (245.0 m)	359.60 (109.6 m) [estimated]	359.60 (109.6 m)

Results

In the Fort Worth District (SWF), between 2014 and 2019, there were a total of 965 NWP permits granted. Our analysis reveals that a total of 165 permits, or 17.1% of all SWF NWP stream impact permits, representing a total of 94,685 linear feet of impacts, are currently regulated (>300 linear feet), but whose areal impacts are <0.10 acres, signaling that they would no longer be regulated under proposed NWP revisions.

Concurrently, in the Galveston District (SWG), there were a total of 289 NWP permits granted during the same time period. We estimate that 26 permits, or 9% of all SWG NWP stream impact permits, would also become no longer regulated under proposed NWP revisions.

Table 2. Permit counts and impacted linear feet by stream order in the SWG and SWF USACE Districts.

	SWG		SWF	
	Permits	**Linear ft of impacts**	**N Permits**	**Linear ft of impacts**
Group 1	8	5,973	95	45,204
Group 2	7	19,422	6	4,654
Group 3	2	2,548	7	4,513
Group 4	19	14,884	57	40,314
Sum	26	42,827	165	94,685

Total permits: 191
Total linear ft affected: 94,685

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