County of San Diego
Water Quality Monitoring Services
Los Coches Creek Storm Drain Outfall Microbial Source Tracking Study
Dry Weather

Final Report

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Acronyms & Abbreviations

APHA	American Public Health Association
cfs	cubic feet per second
CFU	colony forming unit
COC	chain of custody
ddPCR	digital droplet polymerase chain reaction
EDD	electronic data deliverable
EM&TS	Environmental Monitoring & Technical Services
FIB	fecal indicator bacteria
mL	milliliter
MPN	most probable number
MST	microbial source tracking
QA/QC	quality assurance/quality control
QMRA	quantitative microbial risk assessment
RWQC	recreational water quality criteria
SAP	sampling and analysis plan
SCCWRP	Southern California Coastal Water Research Project
SDR	San Diego River
SDRWQCB	San Diego Regional Water Quality Control Board
USEPA	Unites States Environmental Protection Agency
WMA	watershed management area

1.0 INTRODUCTION

In 2010 the San Diego Regional Water Quality Control Board (San Diego Water Board) adopted the *Total Maximum Daily Loads for Indicator Bacteria, Project I – Twenty Beaches and Creeks in the San Diego Region* (SDRWQCB, 2010). Three waterbody segments in the San Diego River Watershed Management Area were included in the total maximum daily load (TMDL) due to elevated levels of fecal indicator bacteria that were impairing beneficial uses.

During a single storm event in 2016 the Southern California Coastal Water Research Project (SCCWRP) detected the presence of a human-associated genetic fecal marker (HF183) at 13 different locations (every location monitored) in the river or tributaries within the San Diego River watershed (SCCWRP, 2016). Due to the prevalence of the human marker during wet weather, the County began an investigative process to characterize the unincorporated portions of the San Diego River watershed to identify and mitigate sources of human-associated bacterial contamination (Brown and Caldwell, 2017). The *San Diego River Microbial Source Tracking Study* was begun in winter of 2017. The study initially targeted wet weather but was broadened to include limited dry weather sampling in the tributary Los Coches Creek Watershed in August of 2017.

The objective of the dry weather *Los Coches Creek Storm Drain Outfall Microbial Source Tracking Study* is to assess dry weather discharges in the unincorporated portion of the Los Coches Creek Watershed for potential sources of human fecal bacteria. This study focused on the collection of grab samples primarily from storm drain outfalls for analysis of human-associated genetic markers and fecal indicator bacteria. This report presents the findings of the study.

2.0 MONITORING AND ASSESSMENT METHODS

2.1 Monitoring Locations

A total of 18 County storm drain outfall stations and one receiving water station were monitored during dry weather conditions (<0.1 in rainfall in previous 72 hours) on August 9 and August 10, 2017 (Table 1, Figure 1). WESTON field scientists collected grab samples at each of the locations with flowing or ponded water. In the event that an outfall was not flowing or ponded, the field scientists indicated the dry condition of the outfall on the field data sheet. Stations for which samples were not collected during the initial visit (due to dry conditions on August 9 or August 10, 2017) were revisited on August 22, 2017 in a follow-up attempt to obtain a sample. All samples were collected between the hours of 8 am and 11 am, in an effort to overlap with one of the peak periods identified for sanitary sewer discharges from single family residences.

Table 1. Los Coches Creek Microbial Source Tracking Monitoring Locations

Station ID	Outfall Location Description	Latitude	Longitude
MS4-SDR-036	South side of Olde Highway 80, 200' west of Bond Ave.	32.84686	-116.8716
MS4-SDR-098	Calle Lucia, 680' N. of Via Diego	32.84121	-116.916
MS4-SDR-127	Harritt Rd., 585' N. of Lake Jennings Park Rd.	32.84912	-116.8842
MS4-SDR-130	Under Cheryl Creek Drive bridge, 170' E. of Shayln Lane	32.84656	-116.8867
MS4-SDR-207	Los Coches Road East, 200' E. of Los Coches Road	32.8327	-116.9053
MS4-SDR-223	Graves Avenue, 760' S. of Greenfield Access, under bridge, need key	32.81238	-116.9614
MS4-SDR-270	Riverside Drive, 612' west of Palm Row Drive, in channel	32.86165	-116.9448
SDR-041	Los Coches Rd. & Via Diego (30" concrete pipe)	32.84005	-116.91324
SDR-1024	Los Coches Creek 1.4 miles from start of concrete channel (30" plastic pipe, under Woodside Ave. tunnel).	32.85678	-116.9253
SDR-740	Los Coches Creek 1.7 miles from start of concrete channel (30" metal pipe, from Woodside Ave.)	32.85715	-116.9301
SDR-751	Los Coches Creek 0.95 miles from start of concrete channel (24" concrete pipe, from Leyendekker Ct.)	32.85310	-116.92077
SDR-754	Los Coches Creek 0.7 miles from start of concrete channel (18" plastic pipe, from Amy Wy.)	32.84988	-116.91993
SDR-768	Los Coches Rd., 50' N. of I-8 Business Route (side outfall)	32.83271	-116.9055
SDR-772	S. side of Los Coches Rd., ~100' W. of Calleja Risa	32.83199	-116.9013
SDR-774A	S. side of Los Coches Rd., 100' W. of Via del Luz	32.83216	-116.89918
SDR-780	End of East Los Coches Rd., behind unit 103 and Caltrans wall, near I-8	32.83635	-116.89258
SDR-782	13901 Hawick Dr. and Cordial Rd.	32.83349	-116.8902
SDR-975	Across from 9215 Ramona Ct. and Sarah Dr.	32.84458	-116.8905
SDR-FC1*	Forester Creek at Lower Forester Creek	32.839347	-116.999866

* Receiving water location

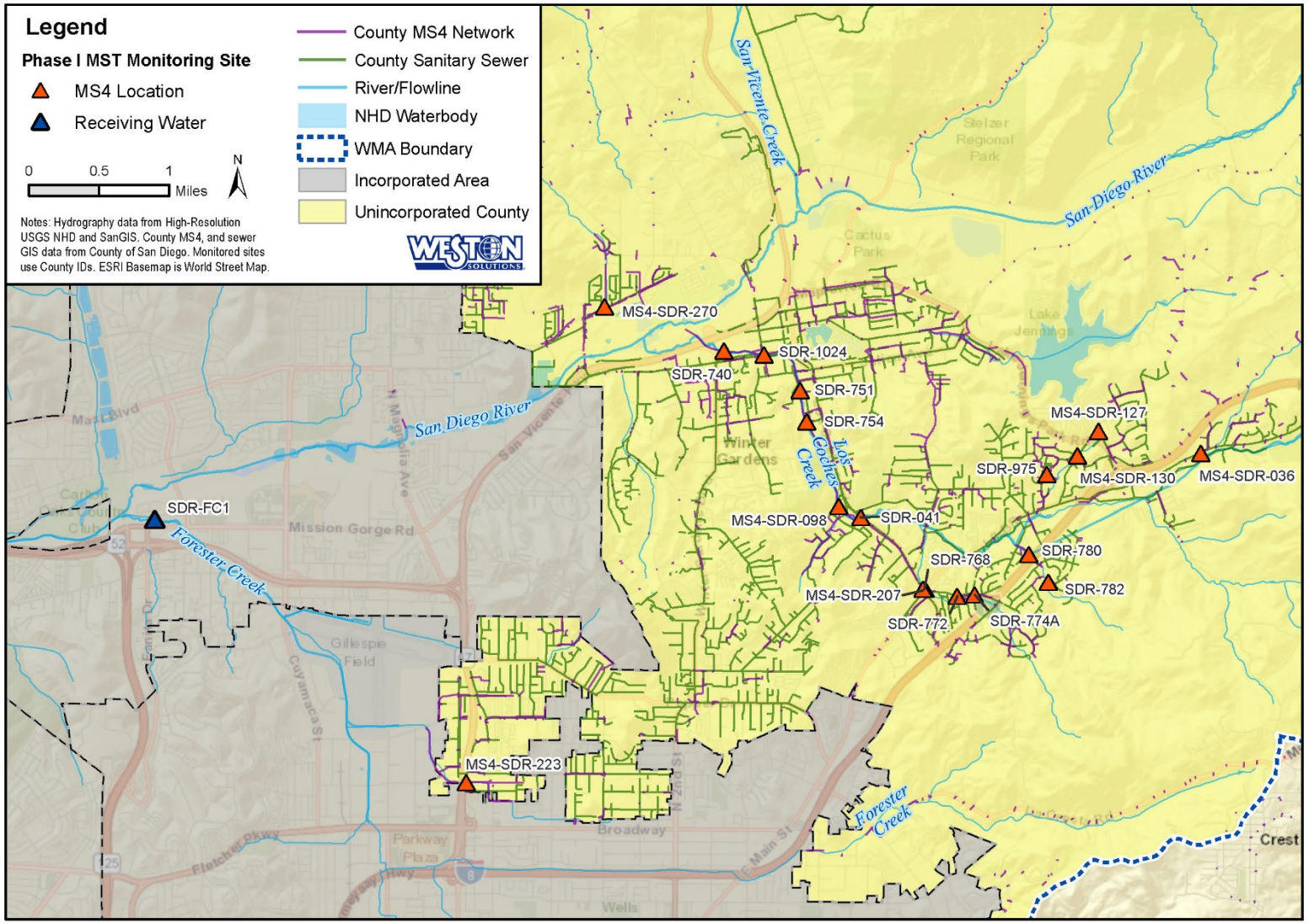

Figure 1. Los Coches Creek Microbial Source Tracking Water Quality Monitoring Locations

2.2 Sampling & Analysis Methods

Samples were collected by field scientists trained in proper sample collection and handling techniques.

Bacteria samples and samples for HF183 analysis were collected in sterile sample bottles by trained personnel and placed into separate clean Ziploc bags. All samples were put on ice for transport to the laboratories for analysis within eight hours. Chain-of-custody (COC) forms (Attachment A) were completed for each sample and appropriate COC procedures were adhered to throughout the transport of the samples. Sample preservatives, where applicable, and holding time requirements were based on recommendations in *Standard Methods (SM) for the Examination of Water and Wastewater* 22nd Edition (American Public Health Association (APHA) et al., 2012) and applicable United States Environmental Protection Agency (USEPA) methods.

During each monitoring event, bacteria samples were collected and transported to the City of San Diego Environmental Monitoring and Technical Services (EM&TS) Laboratory for analysis of *Enterococcus*, *E. coli*, and fecal coliform. Samples collected for human-associated marker analysis HF183 were transported to Southern California Coastal Water Research Project (SCCWRP) for analysis by digital droplet quantitative polymerase chain reaction (ddPCR).

EM&TS analyzed samples for *E. coli* using SM9223B (IDEXX), *Enterococcus* using Enterolert (IDEXX) and fecal coliform using membrane filtration (SM922D) (Table 2). Analysis for the human-associated fecal marker (HF183) was performed by SCCWRP using ddPCR.

Table 2. Monitored Parameters and Laboratory Methods

Analyte	Laboratory	Method
E. coli	EM&TS	SM9223B (IDEXX)
Fecal coliform		SM9222D (membrane filtration)
Enterococcus		Enterolert (IDEXX)
HF183	SCCWRP	HF183 by ddPCR
Flow	Field measurement	March McBirney/ volumetric approximation

ddPCR - digital droplet quantitative polymerase chain reaction

In order to quantify flow; width, depth, and velocity measurements were taken immediately after water quality grabs were collected at each site. WESTON staff measured flow rates using a Marsh McBirney Model 2000 Portable Flowmeter and a top-setting wading rod where possible. At locations in which the flow was not of sufficient depth to use a portable flow meter, flow was approximated by measuring the amount of time it took to fill a container of known volume. At ponded stations, flow was recorded as 0 cubic feet per second (cfs).

Qualitative observations such as water color and odor were also made by WESTON field scientists and recorded on field data sheets (Attachment B). Photographs were also taken at each site and are included as Attachment C.

2.3 Quality Assurance/ Quality Control Samples

Quality assurance/quality control (QA/QC) samples, including a field duplicate sample and a field blank, were collected to assess sample variability and contamination arising from the collection, transport, or storage of samples. There were no detections above the detection limit for HF183 or FIB in the field blank sample that was collected on August 9, 2017. Two field duplicate samples were collected, one each at SDR-041 and SDR-782. Results of the sample and sample duplicate are provided in Table 3. Laboratory reports and electronic data deliverables (EDDs) are included in Attachment A.

Table 3. Field Duplicate Results

Analyte	Units	SDR-041		SDR-782	
		Sample Result	Duplicate Result	Sample Result	Duplicate Result
E. coli	MPN/100 mL	195	461.1	214.3	172.3
Enterococcus	MPN/100 mL	59.2	136.8	934	703
Fecal Coliforms	CFU/100 mL	170	150	100	200
HF183	Copies/100 mL	0	0	0	0

3.0 RESULTS AND DISCUSSION

As previously stated, select storm drain outfalls and one receiving water location within the San Diego River Watershed were investigated to assess dry weather discharges for potential sources of human fecal bacteria. In this study, samples were collected at 18 storm drain outfall stations and one receiving water station. Although 18 outfalls were targeted for sampling in this study, one station, SDR-768, was not sampled due to dry conditions.

3.1 Bacteria Results

Monitoring results are summarized in Table 4. Laboratory reports, EDDs and COC forms are provided in Attachment A.

Fecal coliform, *Enterococcus*, and *E. coli* were detected at all monitored outfall and receiving water locations that were sampled. A graphical representation of the FIB data is shown in Figure 2, and clearly shows that there were five storm drain outfall stations that had higher FIB concentrations (of at least two indicators) than the other outfalls; MS4-SDR-98, MS4-SDR-127, SDR740, SDR-754 and SDR-772.

HF183 was detected at five storm drain outfall stations (Table 4). Station MS4-SDR-098 had the strongest signal for HF183 (1,389 copies/100 mL), followed by stations MS4-SDR-207 (802 copies/100 mL), SDR-780 (518 copies/100 mL), and MS4-SDR-127 (82 copies/100 mL). Station SDR-754 had a weak signal that was below the detection limit and was not quantifiable. No other storm drain outfall or receiving water samples exhibited detections of HF183. Three of the stations with detections of HF183 also had elevated levels of FIB; MS4-SDR-098, MS4-SDR-127, and SDR-754.

There are no regulatory benchmarks for HF183. Although the presence of HF183 indicates the presence of bacteria originating from the gastrointestinal tract of a human, its value does not directly relate to human health risk.

Table 4. Sample Results

Station	Sample Date	Fecal Coliform	*Enterococcus*	*E. coli*	HF183
		CFU/100mL	MPN/100mL	MPN/100mL	copies/100mL
MS4-SDR-098	**8/9/17**	36,000	10,140	21,870	1,389
MS4-SDR-127	**8/9/17**	60,000	34,480	2,909	82
MS4-SDR-207	**8/9/17**	2,800	3,448	4,884	802
MS4-SDR-223	**8/9/17**	30	1,842	4,611	0
MS4-SDR-270	**8/9/17**	1,400	727	1,483	0
SDR-041	**8/9/17**	170	59.2	195	0
SDR-1024	**8/9/17**	1,000	1,664	517.2	0
SDR-130	**8/9/17**	800	2,046	298.7	0
SDR-740	**8/9/17**	52,000	75,400	17,850	0
SDR-751	**8/9/17**	9,000	7,030	4,352	0
SDR-754	**8/9/17**	60,000	36,540	3	BD
SDR-772	**8/9/17**	60,000	48,840	117,800	0
SDR-774A	**8/9/17**	150	115.3	191.8	0
SDR-780	**8/9/17**	600	547.5	862	518
SDR-975	**8/9/17**	3,000	11,060	6,630	0
MS4-SDR-036	**8/10/17**	5,000	2,419.60	6,867	0
SDR-782	**8/10/17**	100	934	214.3	0

BD – below detection limit

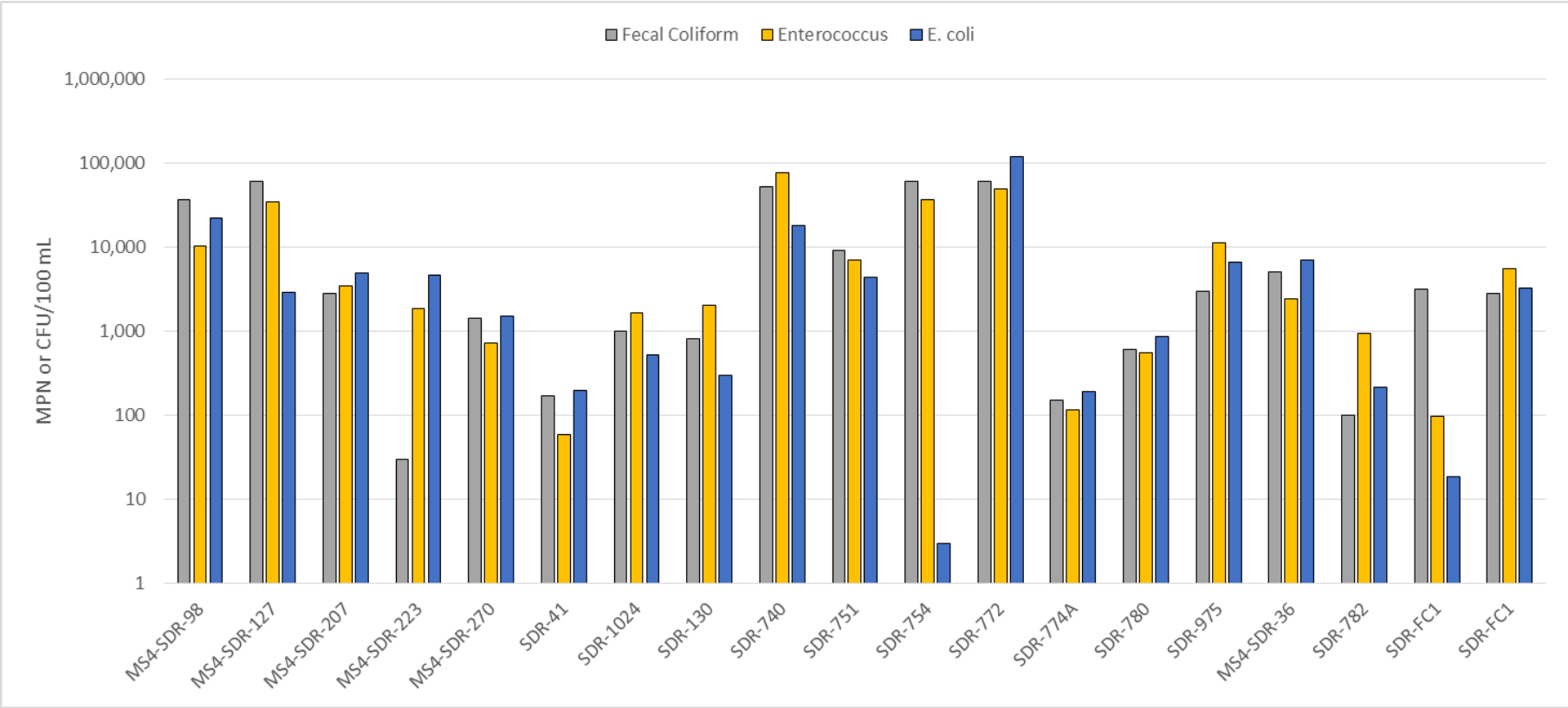

Figure 2. Fecal Indicator Bacteria Concentrations by Station

3.2 Flow Measurements

WESTON scientists also recorded measurements of width, depth and velocity at the outfalls in order to estimate flow. Flow estimates are provided in Table 5. Field data sheets that include measurements of the width, depth, and velocity of observed runoff (or timed volumetric measurements) are provided in Attachment B.

Table 5. Flow Estimates

Monitoring Station	Sample Date	Flow Estimate (cfs)
MS4-SDR-98	8/9/2017	0.00001
MS4-SDR-127	8/9/2017	0.00025
MS4-SDR-207	8/9/2017	0.0053
MS4-SDR-223	8/9/2017	0.0016
MS4-SDR-270	8/9/2017	0.0023
SDR-41	8/9/2017	0.0013
SDR-1024	8/9/2017	0.0002
SDR-130	8/9/2017	Ponded- No Flow
SDR-740	8/9/2017	Slight trickle- flow too low for accurate measurement
SDR-751	8/9/2017	Slight trickle- flow too low for accurate measurement
SDR-754	8/9/2017	0.000001
SDR-772	8/9/2017	0.0001
SDR-774A	8/9/2017	0.049
SDR-780	8/9/2017	0.103
SDR-975	8/9/2017	Ponded- No Flow
MS4-SDR-36	8/10/2017	Ponded – No Flow-
SDR-782	8/10/2017	Ponded – No Flow
SDR-768	8/10/2017 and 8/22/2017	Dry
SDR-FC1	8/9/2017	0.60

NS - not sampled

At most stations, flow from outfalls amounted to little more than a slow trickle. Stations SDR-774A and SDR-780 were the only outfalls that had calculated flows greater than 0.01 cubic feet per second (cfs). At four outfall stations, there was no observed flow at the time of sampling, though they did have ponded conditions, which is indicative of recent flow. There was no flow at station SDR-768 due to dry conditions. The site was revisited on August 22, 2017 and dry conditions were confirmed.

4.0 CONCLUSIONS AND FOLLOW UP STUDIES

Flow from the monitored storm drain outfalls was generally low across all stations. HF183 was detected at five of the 18 monitored MS4 stations (Table 4), and three of these five stations, MS4-SDR-98, MS4-SDR-127, and SDR-754, also had substantially higher FIB than most other stations (Figure 2). HF183 was not detected at the receiving water location SDR-FC1.

Based on the results, the County plans to conduct follow-up investigations to look more closely at the drainage areas that flow into the following outfalls to determine the potential sources of human fecal bacteria: MS4-SDR-98, MS4-SDR-127, MS4-SDR-207, and SDR-780.

5.0 REFERENCES

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