

# WORLD MINE TAILINGS FAILURES

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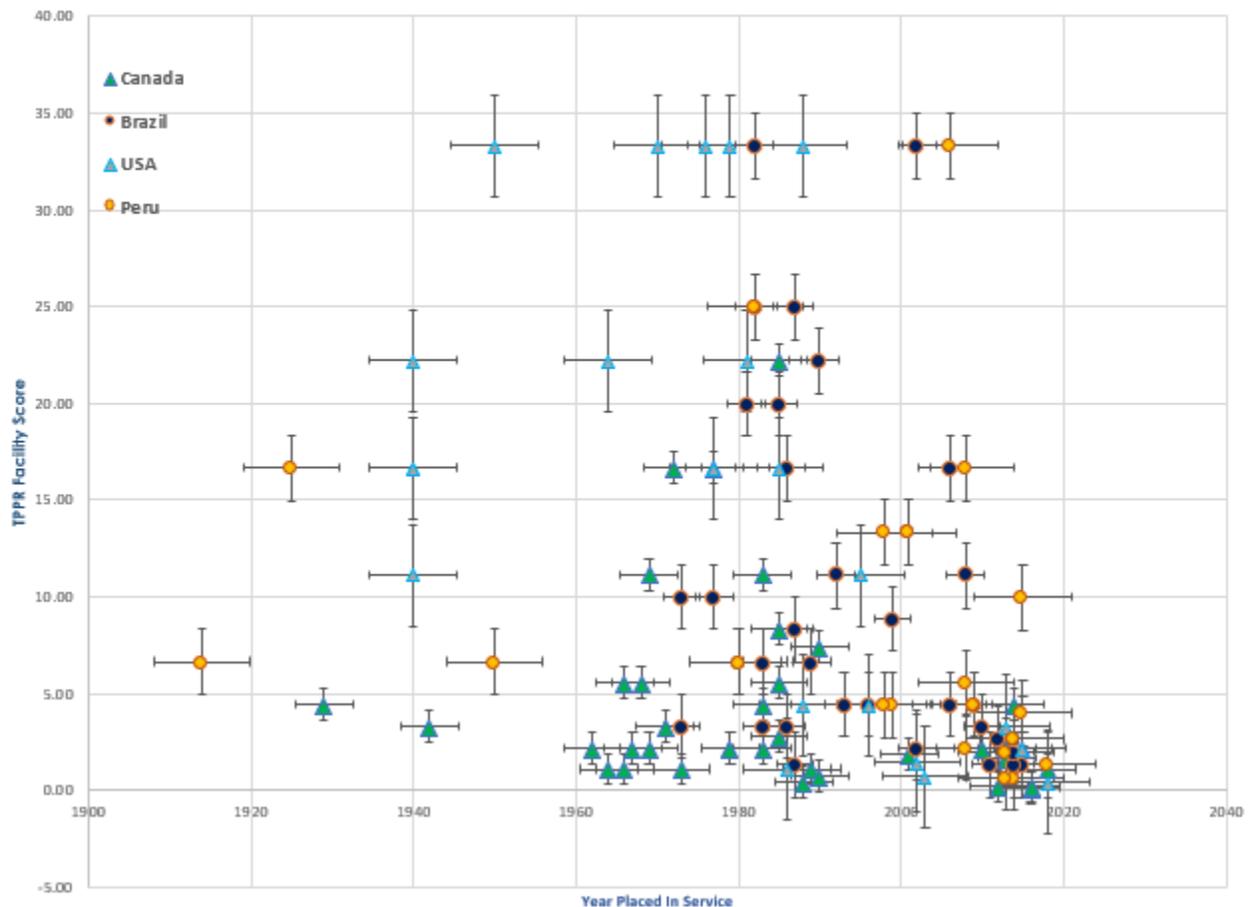
## HIGH POTENTIAL RISK IN NEARLY 1/3 OF ACTIVE HIGH HAZARD POTENTIAL TAILINGS FACILITIES BRAZIL PERU USA AND CANADA

For Immediate Release March 15, 2021

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TPPR POTENTIAL RISK IN ACTIVE COE CLASSIFIED HIGH HAZARD POTENTIAL TSFs (N=114)  
Brazil, Peru, USA, Canada TPPR By Year Placed In Service

OVERALL 27% OF ALL ACTIVE HIGH HAZARD POTENTIAL TSFs IN THESE 4 COUNTRIES HAVE ACTION LEVELS OF POTENTIAL RISK (n=31)



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**WMTF** has developed a Tailing Portfolio Potential Risk index **TPPR** for use by insurers, investors, creditors, regulators, companies and by communities in the catastrophic failure radius. This data set is 114 records of active “High Hazard Potential” facilities (as designated by owner operator) from the COE disclosure portfolio. It was created as part of **WMTF’s** rigorous vetting of the **TPPR’s** reliability in pinpointing those facilities for which it is most urgent to have immediate proof of stability assurance by competent persons using methods and inputs

appropriate to each facility. In this data set of only facilities in Brazil, Peru, Canada and USA, 27% had **TPPR** scores at or above the action level of proof of stability. The range of **TPPR** scores within the “action level” are: Extreme, >60; Very High, 20 to 60; High, 10 to 20. None of the data set facilities score “extreme”.

HIGH HAZARD POTENTIAL TPPR RISK POTENTIAL & ACTION LEVELS										
AVERAGE TPPR COMPONENT SCORES						TPPR ACTION LEVEL				
	Country	TPPR AVG	Age	Raise	Capacity	Count	VERY HI	HI	TOTAL	
Max	15		15	10	30					
	Canada	5	4	12	5	11	38	1	5	16%
	USA	5	15	12	7	20	22	8	6	64%
	Peru	15	9	9	3	15	23	2	5	30%
	Brazil	15	10	11	4	12	31	4	0	13%
Total #							114	15	16	27%
Total %							100%	13%	14%	

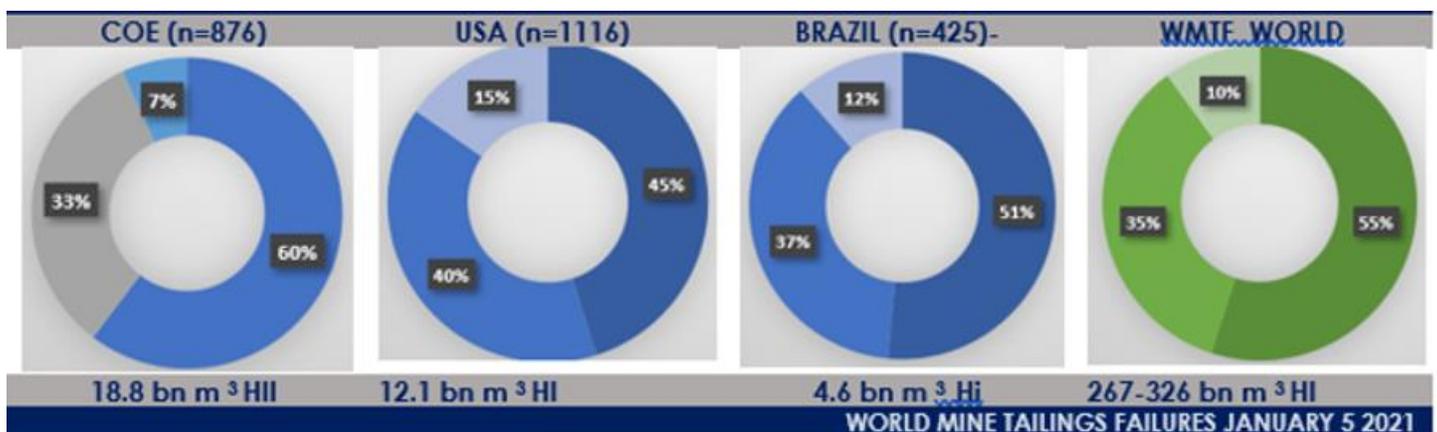
TPPR= Country\*Age\*Raise\*Capacity\*status)/maxscore1675) max=100 ( status "active"=10 (all 10 in this table)

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Overall, in these 4 nations 27% of active facilities operator classified as “High Hazard Potential” also classify as High Potential Risk” in **TPPR**. The USA had the highest **TPPR** index. 64% of the selected portfolio of all active “High Hazard Potential” facilities are at or above the minimum action level. 12 of the 14 USA action level facilities are owned/operated by a single company.

“Hazard Potential” includes no indicators of actual risk of failure. It indicates only severity magnitude should a failure occur and is used primarily to sets the level of care and due diligence owed in the design and management of the facility.

55% of all facilities in the world TSF portfolio (active, inactive, abandoned) are classified as “High Hazard Potential”.



**12,000 facilities out of the 29,000 to 35,000 total world wide are “active”** and a guestimate worldwide is that 6,000 of these are “high hazard potential”. Applying the 27% “High Risk Potential” leads to an estimated 1,620 TSF’s worldwide receiving world mineral production wastes over the next 5 years which should already have proof of stability (by independent competent persons using methods appropriate to the tailings characteristics and the facility conditions (e.g. saturated or not, density, granulometry)) and should be able to furnish that on

demand to all potentially affected stakeholders: insurers investors, creditors, regulators and, of course potentially at risk communities.

A “High Potential Risk” status clearly is in the realm to “right to know” by all potentially affected stakeholders. It has its own immediate consequence for property owners similar to being in an area designated for urban renewal.

Each of the 5 components of the index (Country, Age, Construction Type, Current Volume of stored tailings (Size/ (Capacity) and Operating Status) is rooted in the **WMTF** TSF Failures data base and our thousands of pages of research records on major failures in recorded history.

For example, USA and Canada each have a score of 5 on “country” and are comparable to one another both in terms of total failure history (cumulative failure magnitude) relative to number of facilities and relative to world mineral production. Peru and Brazil each have a score of 15 on “country”, the maximum score, and are also similar to one another on these two failure reference points.

NATIONAL FAILURE HISTORY							
COUNTRY	RELATIVE TO #TSF'S			RELATIVE TO MINERAL PRODUCTION 2016			
	FAILURE MAGNITUDE	# TSFs	RATIO FAIL/FAC	PRODUCTION M m3	% WORLD	MAGNITUDE % WORLD	RATIO MAG/PROD
CANADA	13	385	0.034	439	2.6%	3.1%	0.012
BRAZIL	73	769	0.094	489	2.9%	16.8%	0.391
USA	71	1635	0.044	1937	11.5%	16.5%	0.007
PERU	36	115	0.319	34	0.2%	8.4%	0.422

HIGHEST TPPR SCORES IN DATASET					
	Score	Current vol	Planned vol	Raise	Built
CANADA	22	68,000,000	68,000,000	Upstream	1985
USA	33	214,080,000	251,540,000	Upstream	1988
PERU	33	329,000,000	472,000,000	Centreline	2006
BRAZIL	33	110,000,000	154,000,000	Centreline	2002

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THE COE disclosures do not provide adequate or reliable confirmation of stability for any facility classified as “High Hazard Potential” and even less assurance when actual risk indicators are brought to bear via the **TPPR**.

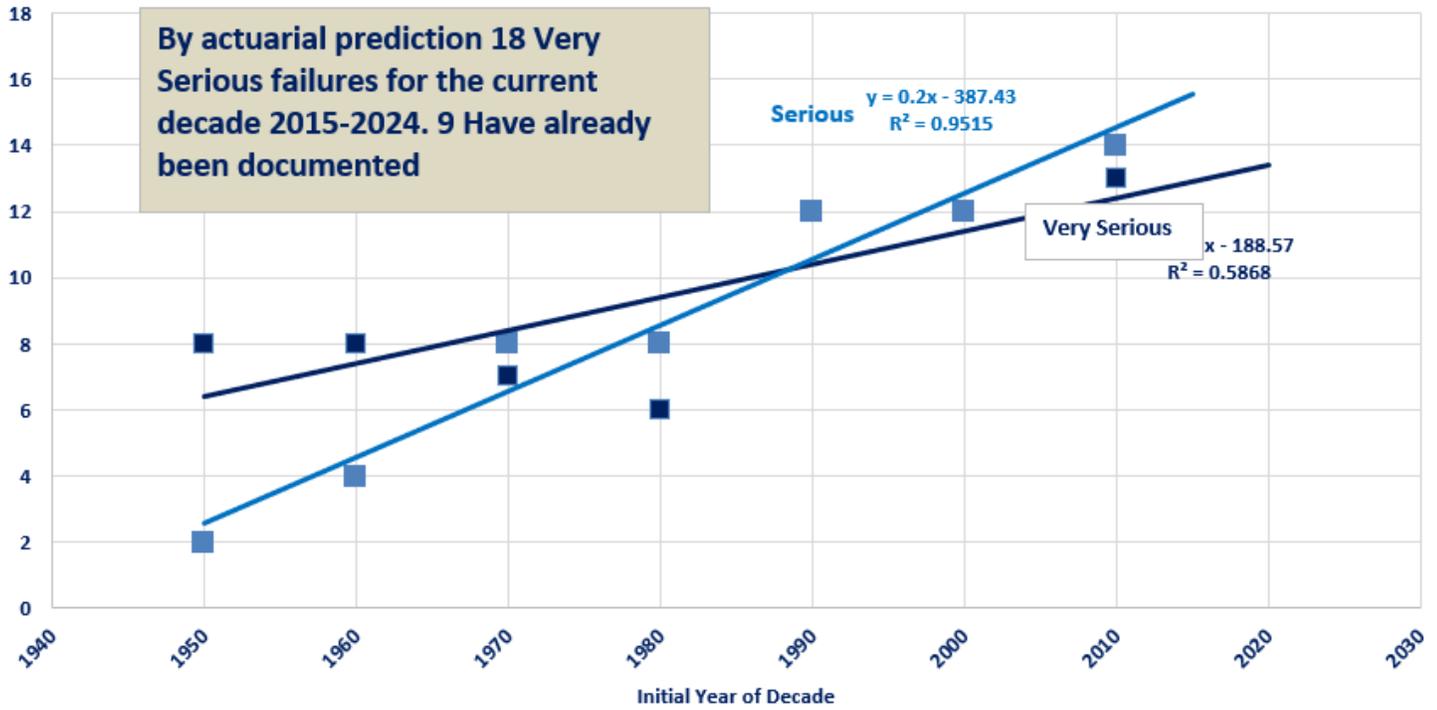
**WMTF's** guidance on "High", "Very High" and "Extreme" is for the regulator to make a public demand for the actual stability analysis and to arrange for independent assessment of that work by competent experts. If no work can be produced, the potentially affected community and all financial stakeholders should be notified by order of the regulator and all depositions should cease until stability is assured. If the current legal framework does not allow these actions, it should be modified under emergency provisions.

All facilities with these "action level" **TPPR** scores should be made known publicly by the regulators in on line machine readable (excel) form for download on demand and provide funded experts to represent and inform the potentially at risk community until the action level status is resolved.

All active “high hazard potential” TSF's are deeply co entangled with mineral production. They comprise 50 to 60% of all active facilities.

These 4 nations and many others are looking to “high potential risk” TSF’s for the storage of billions of cubic meters of mineral production over the next 5 years.

### VERY SERIOUS AND SERIOUS FAILURES BY DECADE 1950-2019



WORLD MINE TAILINGS FAILURES DATABASE THROUGH 03/15/2021