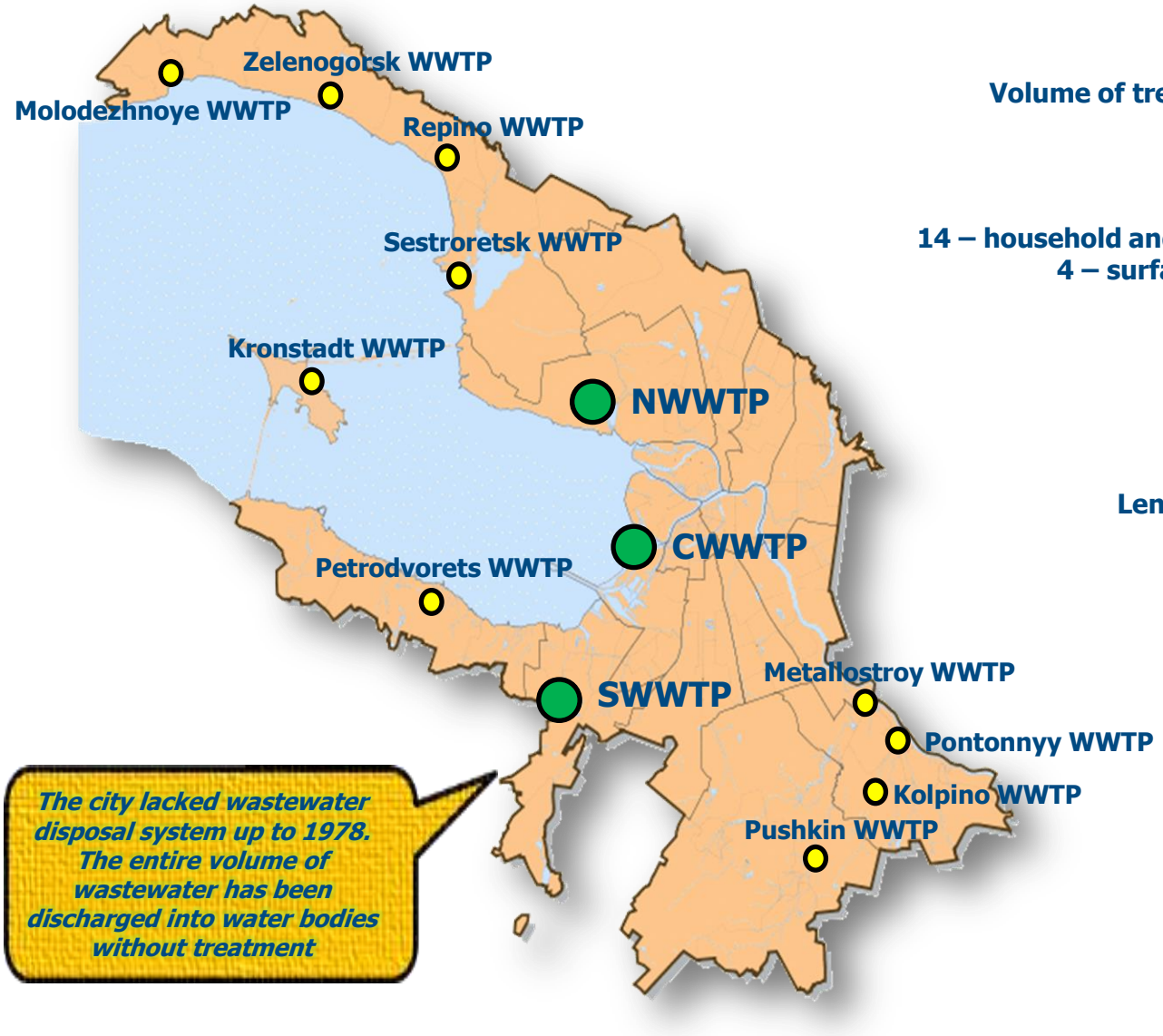
Draft Program for SUE “Vodokanal of St.Petersburg” Environmental Performance Improvement

St.Petersburg Wastewater Disposal System



The city lacked wastewater disposal system up to 1978. The entire volume of wastewater has been discharged into water bodies without treatment

Volume of treated wastewater– 2.2 mln. m^3/day

18 Wastewater treatment plants:

14 – household and combined sewage treatment;
4 – surface runoff treatment

Network length is 8919.9 km

Length of tunnel collectors – 270.7 km

208 Sewage pumping stations

3 Sludge incineration plants

Helsinki Convention

1998 год – **Convention on the Protection of the Marine Environment of the Baltic Sea was approved by the Russian Federation Government Decree № 1202 dated October 15, 1998**.

Principal objective of the Convention – protection of the natural marine environment of the Baltic Sea from all pollution sources, reclamation and preservation of the Baltic Sea environmental balance, provision of sustainable use of its natural resources.

HELCOM recommendation 28E/5 "Wastewater Treatment"

Effluent quality parameters	1999	2006	2008-2014
$Nitrogen_{tot}$, mg/l	**<10.0**	**<10.0**	**<10.0**
$Phosphorus_{tot}$, mg/l	**<1.5**	**<1.0**	**<0.5**

St.Petersburg Wastewater Composition

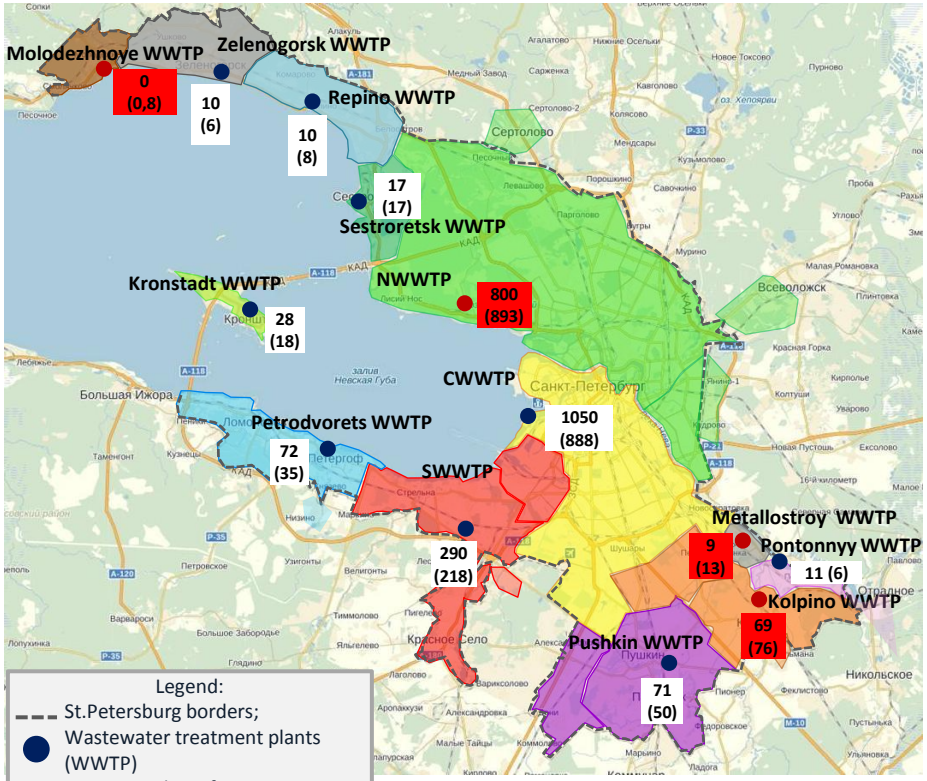
70% of St.Petersburg is served with combined wastewater disposal system

Household wastewater

Surface runoff

Industrial wastewater

Current Balance of Combined and Household Wastewater Disposal System in 2017



Legend:

- Zelenogorsk WWTP catchment area;
- Repino WWTP catchment area;
- Molodezhnoye WWTP catchment area;
- NWWTP catchment area;
- CWWTP catchment area;
- SWWTP catchment area;
- Kronstadt WWTP catchment area;
- Petrodvorets WWTP catchment area;
- Pushkin WWTP catchment area;
- Kolpino WWTP catchment area;
- Pontonnyy WWTP catchment area
- Metallostroy WWTP catchment area
- Sestroretsk WWTP catchment area

1050 - Reduced capacity, thou. m3/day.
(888) - (Actual daily treatment in 2017, thou. m3/day)

800 (893) WWTP performance deficiency

Wastewater disposal system challenges

- **56% (in volume) of biological treatment facilities are not rehabilitated with up-to-date technologies, which ensure treatment performance stability;**
- **77% of effluent is nor disinfected;**
- **69% of effluent samples do not comply with set standards for not process controlled pollutants (in characteristics);**
- **Wastewater treatment facilities performance deficiency in separate catchment areas;**

	2017
WWTPs reduced capacity, thou. m3/day	2437
Wastewater treatment at WWTPs, thou. m3/day	2231
Capacity deficiency (-)/reserve (+), thou. m3/day	206

St.Petersburg Water and Wastewater Master Plan Updating Basis

St.Petersburg Water and Wastewater Master Plan till 2025 with an outlook to 2030 was approved by the St.Petersburg Government Resolution no. 989 dated 11 December 2013 (amended by the St.Petersburg Government Resolution no. 856 dated 25 September 2015).

Updating (adjustment) of the Master Plan is carried out in accordance with clause 8 of the "Rules for Development and Approval of Water and Wastewater Master Plans" approved by Resolution of the Government of the Russian Federation No. 782 dated September 5, 2013.

Documents, applied for updating (adjustment) of the Master Plan :

- Master plan of St. Petersburg, approved by the Law of St.Petersburg No. 728-99 dated December 21, 2005 (with amendments of 2018).
- Strategy of economic and social development of St.Petersburg for the period up to 2030, approved by the St.Petersburg Government Resolution No. 355 dated May 13, 2014.
- Resolutions of the Government of St.Petersburg on the approval of planning projects with the landmarking projects.
- General and Master plans for water supply and wastewater disposal of municipalities in the Leningrad Region within the agglomeration of St.Petersburg and the Leningrad Region.

- State Program of St.Petersburg "Integrated Development of Utilities Infrastructure, Energy and Energy Saving Systems in St.Petersburg" for 2015-2020, approved by the Resolution of the Government of St.Petersburg No. 486 dated June 17, 2014 (as amended on December 26, 2017).
- State Program of St.Petersburg "Economic and Social Development of the Territories of St.Petersburg" (subprogram "Preservation and Development of the Historic Center of St.Petersburg"), approved by the Resolution of the Government of St.Petersburg No. 551 dated June 30, 2014 (as amended on January 23, 2018) .
- State Program of St.Petersburg "Urban Improvement and Environmental Protection of St.Petersburg", approved by the Resolution of the Government of St.Petersburg No. 487 dated June 17, 2014 (as amended on February 14, 2018)

- Statistical bulletin "Estimated Population of St.Petersburg and Leningrad Region up to 2035" (PETROSTAT) No. BC-140/1472 dated 09.06.2017.
- Regional urban planning standards (RUPS).

- Master plan of St.Petersburg heat supply for the period up to 2031, approved by the Order of the Ministry of Energy of Russia No. 1330 dated 16.12.2016.
- Master plan and program for the future development of St.Petersburg power industry for 2017-2021, approved by the Governor of St.Petersburg Order No. 66-пг dated June 27, 2017.
- Federal Law No. 219-FZ dated 21.07.2014 "On Amendments to the Federal Law "On Environmental Protection" and Certain Legislative Acts of the Russian Federation" (as amended and supplemented).

Federal Law № 219-FZ "On Amendments Being Made to the Federal Law "On Environmental Protection" and Certain Legislative Acts of the Russian Federation" (27.07.2014)

- It was directed for a phased transition to a BAT indicators based system of technological standards
- Technological standards - standards for emissions, discharges of pollutants, standards of permissible physical impacts, which are established with **technological parameters**;
- BAT is considered as an economically feasible technology implemented on at least 2 sites, which provides the lowest level of negative impact on the environment;
- BAT should be implemented at Category I classified sites (**sites that have a significant negative impact on the environment and are relevant to the areas of the best available technologies application**);
- BAT information and technical reference books for various areas of economic activity serve as basis for the transition to technological regulation.
- Technological standards are established: **with respect to marker substances – specific pollutants of the applied technology emissions and discharges**.

Federal Law №219-FZ dated 21.07.2014
BAT and Technological Standards

Stages of transition to BAT and technological standards

2015 - 2018	2019 -2022	Up to 2025
✓ Regulations adoption ✓ Development and publishing of BAT-46 reference books	Issuance of integrated permits based on environmental performance improvement programs (presumably 300 pilot companies)	Distribution of requirements for large companies (33 areas of application)

Implementation of environmental performance improvement programs (14 years for monotowns, 7 years for others)

Enhanced economic sanctions and benefits

"List of 300" Sites

In accordance with the Order of the Ministry of Natural Resources of the Russian Federation No. 154 dated 18.04.2018 "**On approval of the list of Category I sites that have negative impact on the environment, whose contribution to total emissions and discharges of pollutants in the Russian Federation exceeds 60 percent**".
(The Order was prepared by the Ministry of Natural Resources of the Russian Federation. It has not been put into effect, since it has not been registered by the Ministry of Justice of the Russian Federation):

- ✓ **South-West Wastewater Treatment Plant**
- ✓ **Central Wastewater Treatment Plant**
- ✓ **Northern Wastewater Treatment Plant**

Included in the "List of 300": IEP obtaining term is 2019 - 2022

BAT Based Regulation of Wastewater Treatment Quality Parameters

Federal Law № 219-FZ dated 21.07.2014 "On Amendments Being Made to the Federal Law "On Environmental Protection" and Certain Legislative Acts of the Russian Federation"

entered into force on January 1, 2015, ***with the exception of provisions on the transition to the best available technologies (BAT) since 01.01.2019***

Sites

1 Category	2 Category	3 Category	4 Category

Environmental Impact

Significant	Moderate	Subtle	Minimal

Transition to the BAT information and technical reference books based technological regulation

1 Category- obligatory

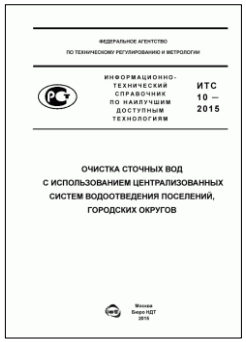
OBTAINING INTEGRATED ENVIRONMENTAL PERMITS.

- **Northern wastewater treatment plant – 2019-2022**
- **Central wastewater treatment plant – 2019-2022**
- **South-West wastewater treatment plant – 2019-2022**
- **Pushkin wastewater treatment plant – prior 2025**
- **Kolpino wastewater treatment plant – prior 2025**
- **Petrodvorets wastewater treatment plant – prior 2025**

Integrated Environmental Permit sets: (Article 31.1. FZ № 219 dated 21.07.2014)

- **Technological standards for discharges and emissions** (based on BAT technological indicators in accordance with sector-specific BREFs);
- **Standards for permissible emissions, standards for permissible discharges of radioactive, highly toxic substances, substances with carcinogenic, mutagenic properties** (substances of I, II hazard class), if such substances are found in emissions, discharges of pollutants;
- **Wastes generation standards and allocation limits**;
- **Production environmental control program** (in all environments);
- **Environmental performance improvement program** (if technological standards for discharges and emissions are not reached)
- **Planned temporarily permitted emissions, temporarily permitted discharges for the period of environmental performance improvement program implementation**.

Information and technological reference book (BREF-10-2015) "Wastewater treatment using centralized sewerage systems in settlements and urban districts" (approved by the order of Gosstandart dated 15.12.2015 no.1580)



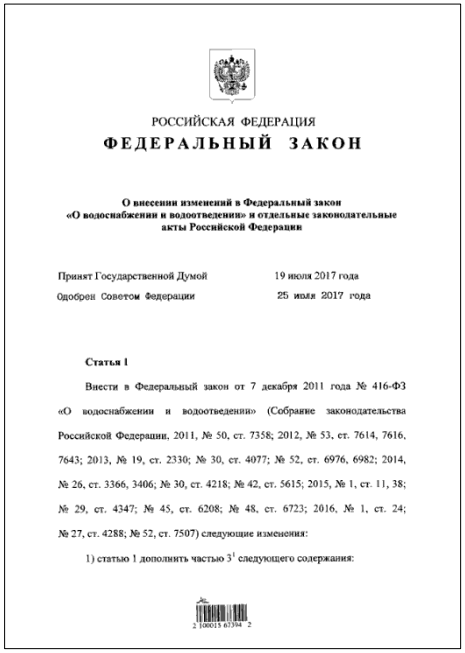
BREF-10-2015 has confirmed officially that no substance categorized as specific industrial pollutant may be put on the list of regulated technological parameters for water companies' biological treatment facilities.

BREF-10-2015 recommends to set **technological standards** for water companies' effluent on the basis of BAT with regard to:

1. capacity of the treatment plant serving a community;
2. environmental category of recipient water body:

- ✓ **Category A.** Specially protected and most vulnerable water bodies with full or partial restriction of economic use (the group that requires the most effective technologies).
- ✓ **Category B.** The main group of water bodies (including the Baltic Sea).
- ✓ **Category C.** Environmentally sustainable water bodies.
- ✓ **Category D.** Water bodies with particularly low concentrations of nitrogen and phosphorus, for which biological treatment without enhanced nitrogen and phosphorus removal (under 30 % removal) can be permitted subject to a relevant justification.

Federal law dated 29 July 2017 no. 225-FZ "On amending the Federal law "On Water Supply and Sanitation" and some legal acts of the Russian Federation" (coming into effect in 2019)



РОССИЙСКАЯ ФЕДЕРАЦИЯ

ФЕДЕРАЛЬНЫЙ ЗАКОН

О внесении изменений в Федеральный закон «О водоснабжении и водоотведении» и отдельные законодательные акты Российской Федерации

Принят Государственной Думой 19 июля 2017 года

Одобрен Советом Федерации 25 июля 2017 года

Статья 1

Внести в Федеральный закон от 7 декабря 2011 года № 416-ФЗ «О водоснабжении и водоотведении» (Собрание законодательства Российской Федерации, 2011, № 50, ст. 7358; 2012, № 53, ст. 7614, 7616, 7643; 2013, № 19, ст. 2330; № 30, ст. 4077; № 52, ст. 6976, 6982; 2014, № 26, ст. 3366, 3406; № 30, ст. 4218; № 42, ст. 5615; 2015, № 1, ст. 11, 38; № 29, ст. 4347; № 45, ст. 6208; № 48, ст. 6723; 2016, № 1, ст. 24; № 27, ст. 4288; № 52, ст. 7507) следующие изменения:

1) статью 1 дополнить частью 3^1 следующего содержания:

1. For water companies' facilities classified as Category 1 (*significant negative impact on the environment, the total discharge of WWTP is over 20,000 m3/day*), technological standards are laid down in the Integrated Environmental Permit (IEP).

2. The technological standards are set **on the basis of the technological parameters laid down in BREF-10-2015 "Wastewater treatment using centralized sewerage systems in settlements and urban districts" approved on 15 December 2015, in consideration of:**

- ✓ the capacity of treatment plants within centralized sewerage systems of communities or urban districts,
- ✓ category of water body (or its part) receiving the effluent.

3. A similar procedure is used to set technological standards for Category II facilities when the Integrated Environmental Permit is issued for them.

4. To implement paragraphs 1 and 2 above, the Russian Government has to approve the procedure for correlating the technological parameters in BREF-10-2015 with WWTP capacity and the categories of water bodies.

BAT Process Parameters for SUE "Vodokanal of St.Petersburg" 1 Category Sites

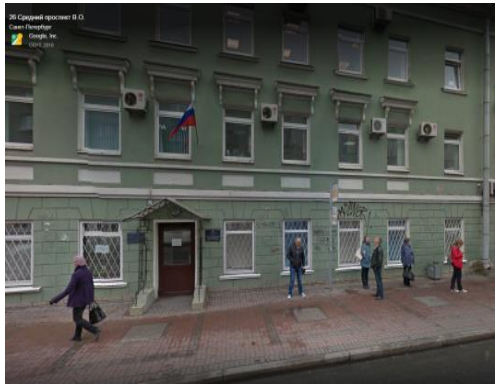
BAT process parameters for SUE "Vodokanal of St.Petersburg" 1 Category sites in accordance with:

- BREF-10 -2015 "Wastewater treatment of settlements, urban districts using centralized wastewater disposal systems";
- draft Decree of the Government of the Russian Federation "On approval of technological indicators of the best available technologies in the field of wastewater treatment of settlements, urban districts using centralized wastewater disposal systems"

Parameter	Unit	BREF-10-2015 (BAT 7z)*	Helcom**
Suspended solids	mg/dm3	10.0	-
BOD5		8.0	15.0
COD		80	-
Ammonium salts nitrogen		1.0	-
Nitrogen nitrites		0.1	-
Nitrogen nitrates		9.0	-
Phosphorus phosphates		0.7	-
Total phosphorus		-	0.5
Total nitrogen		-	10.0

*BAT 7z - Treatment with biological removal of nitrogen and biological and chemical removal of phosphorus with acidification.
**Requirements of agreements are applied when discharges are made to a water body subject to international agreements, and in cases where they are more stringent than these indicators, or are made against other substances (indicators).

Wastewater Treatment Plants Effluent Quality Control System



Federal Agency for Water Resources
Neva-Ladoga Basin Water Management Board

Wastewater treatment quality control system covers all stages of wastewater treatment

Independent control of wastewater quality

Wastewater quality measuring program

SUE "Vodokanal of St.Petersburg" on-site laboratories for the wastewater quality control.

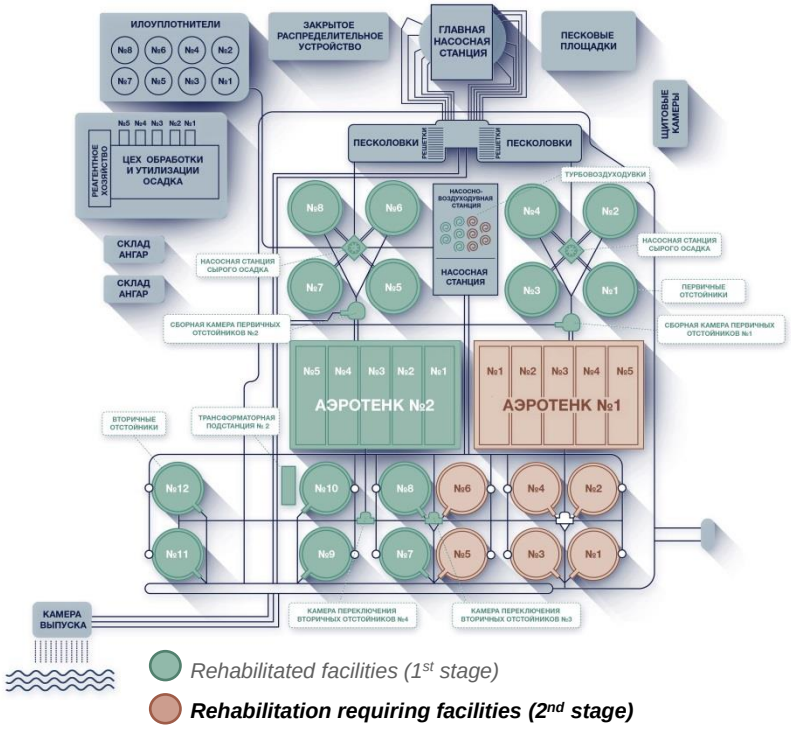
Wastewater treatment process modes control

Northern Wastewater Treatment Plant

Northern wastewater treatment plant characteristics	
Commissioning year	**1986-1995**
Full rehabilitation, 1 stage	**2017**
Reduced capacity:	**800 thou.m^3/day**
Actual capacity in 2017:	**892.7 thou.m^3/day**

Current challenges

- Plant reduced capacity deficiency, taking into account the city northern part territories development and the Leningrad Region sites connection.
- 50% of facilities are not rehabilitated with implementation of the up-to-date technologies that ensure persistent treatment quality.
- Absence of tertiary treatment and disinfection facilities.
- Low contents of organic matter in wastewater.
- Increase of the hydraulic load, as well as nitrogen, phosphorus, suspended solids loads.
- According to the 2017 results, **70%** of samples do not meet the established standards for specific pollution (not related to process controlled).
- High sludge index (230-240 cm3/g).

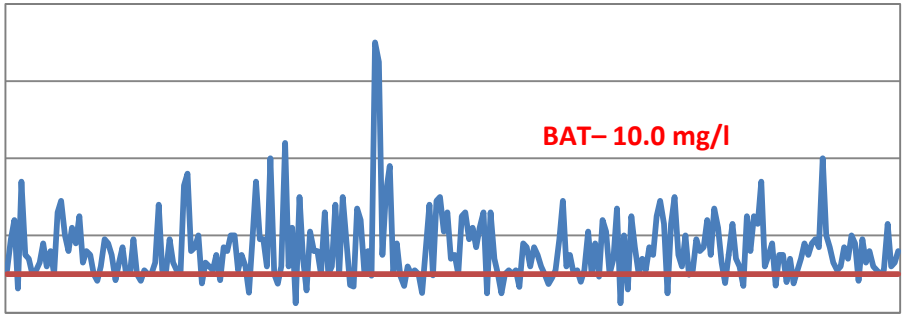


Northern Wastewater Treatment Plant

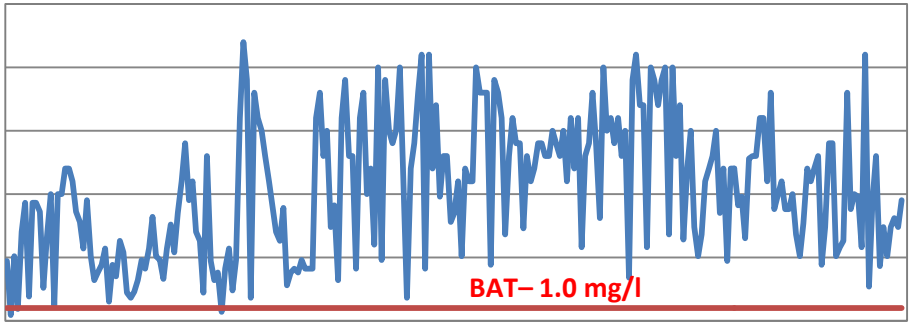
Treatment quality, mg/dm3

	Suspended solids	Ammonium nitrogen	Phosphorus phosphates	Nitrogen nitrates	BOD5	Total nitrogen	COD
Rehabilitated facilities	< 5	< 1	<0.1	6.0	3.3	10.6	33
Rehabilitation requiring facilities	15-30	5-12	<0.1	2.0			
Technological parameter	10	1.0	0.7	9.0	8.0	10	80

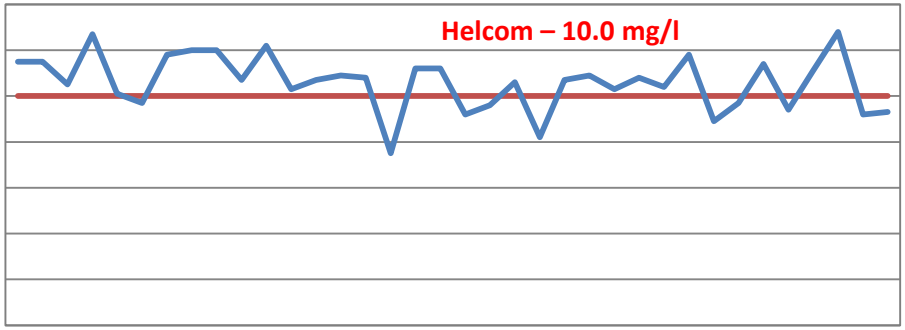
Suspended solids treatment trend



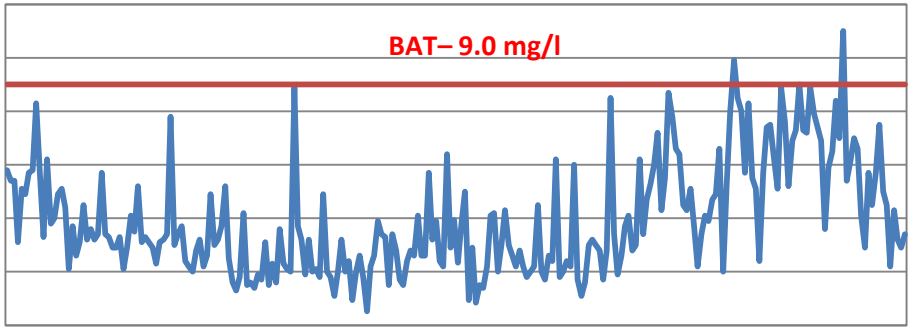
Ammonium nitrogen treatment trend



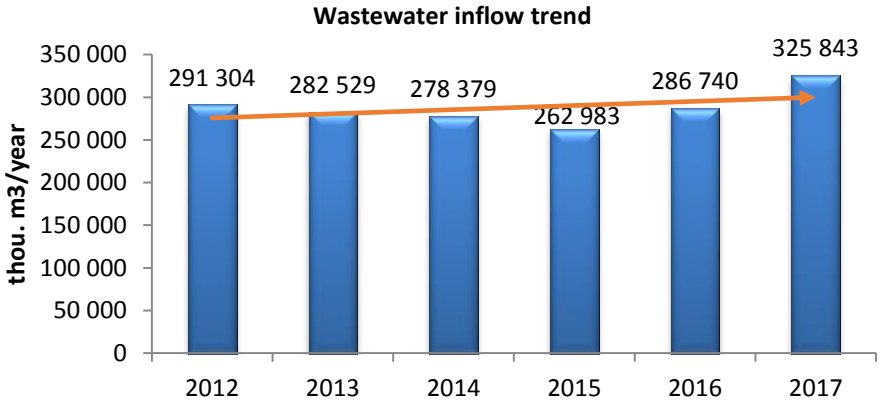
Total nitrogen treatment trend

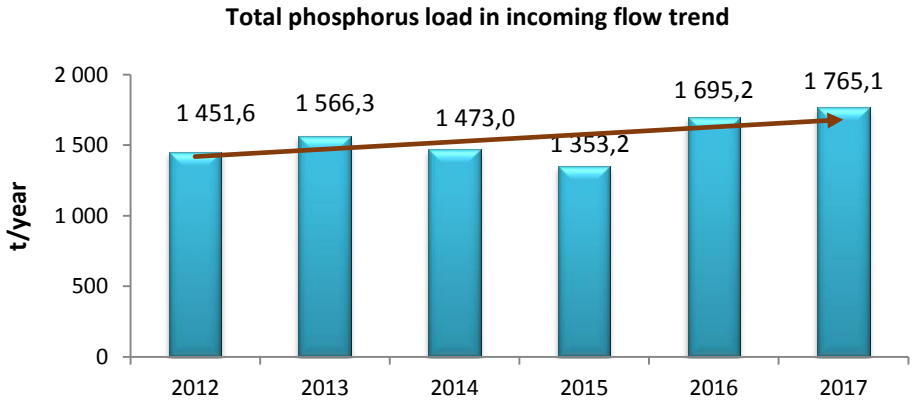


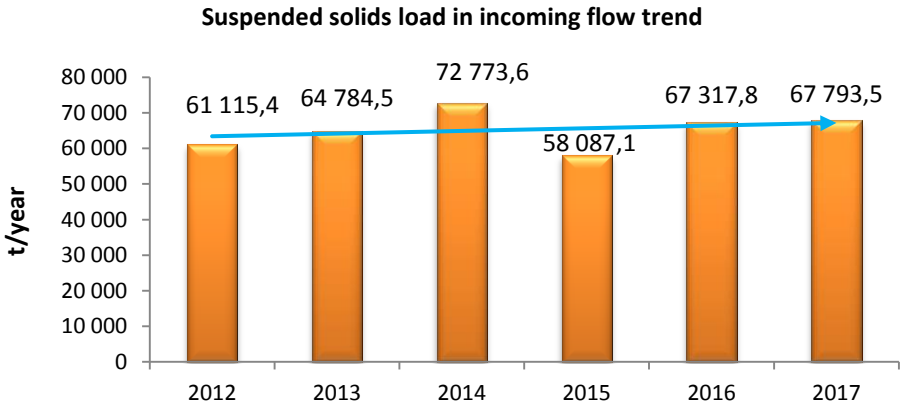
Nitrogen nitrates treatment trend

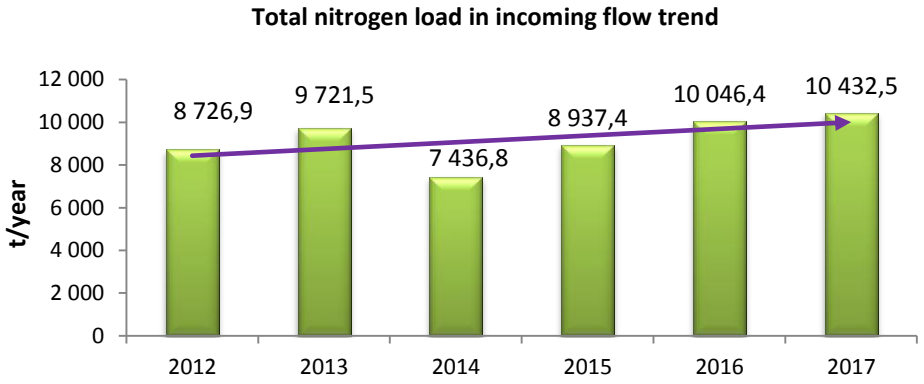


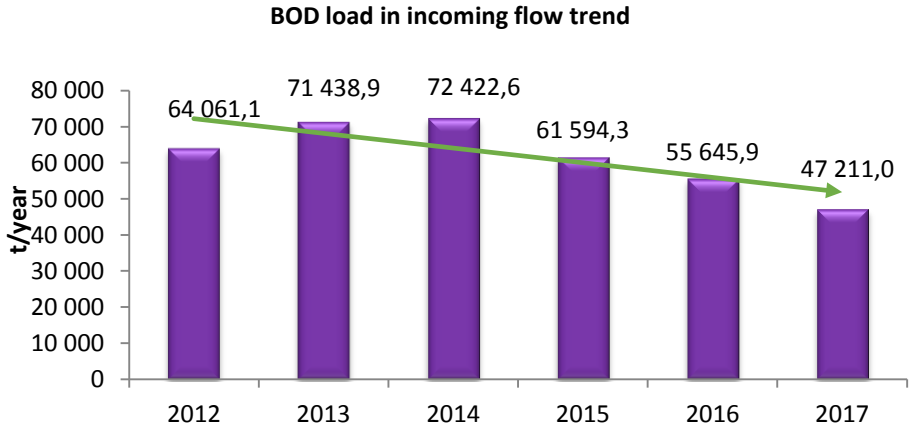
NWWTP Inflowing Pollutants in 2012-2017









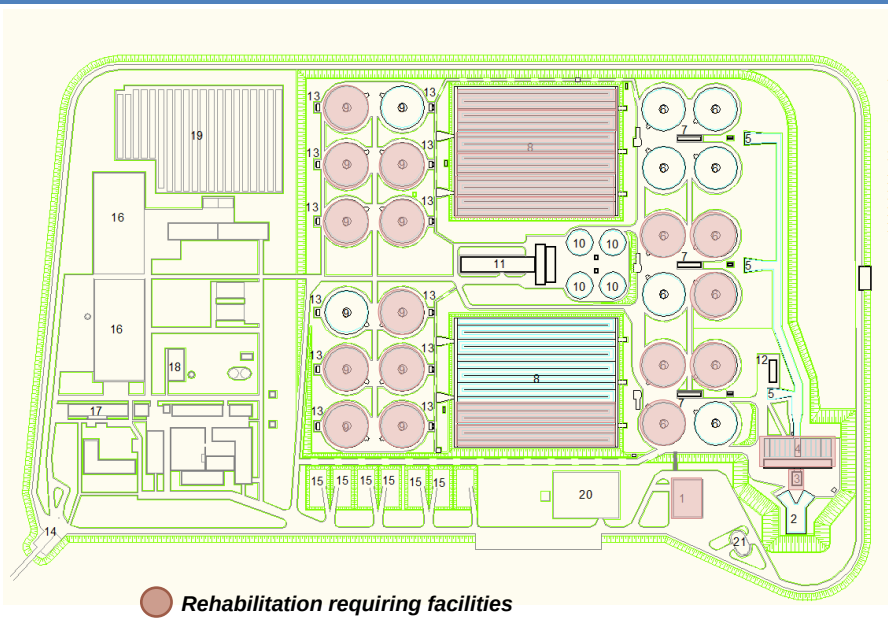


EPIP Planned Activities for the Northern Wastewater Treatment Plant

- Northern wastewater treatment plant rehabilitation 2nd stage, comprising:
  - ✓ modernization of 5 sections of aeration tank and 6 secondary sedimentation tanks;
  - ✓ replacement of 5 blower units with new regulated air supply ones;
  - ✓ construction of new return and excess sludge pumping stations and a transformer substation.
- 3 stage of rehabilitation: tertiary treatment and disinfection facilities construction.
- Raw sludge preliminary fermentation process implementation.

Central Wastewater Treatment Plant

Central wastewater treatment plant characteristics	
Commissioning year	**1978-1983**
Latest rehabilitation (aeration tanks №3,4)	**2012**
Reduced capacity:	**1050 thou.m^3/day**
Actual capacity in 2017:	**888.3 thou.m^3/day**



Current challenges

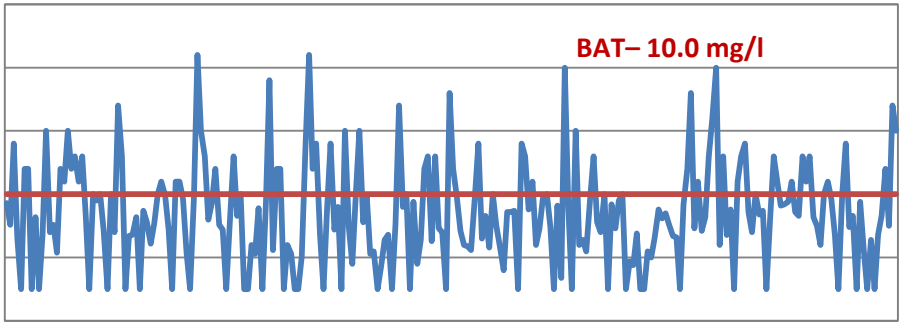
- 50% of facilities are not rehabilitated with implementation of the up-to-date technologies that ensure persistent treatment quality.
- Absence of tertiary treatment and disinfection facilities.
- Low contents of organic matter in wastewater.
- According to the 2017 results, **69%** of samples do not meet the established standards for specific pollution (not related to process controlled).
- High sludge index (170-180 cm3/g).

Central Wastewater Treatment Plant

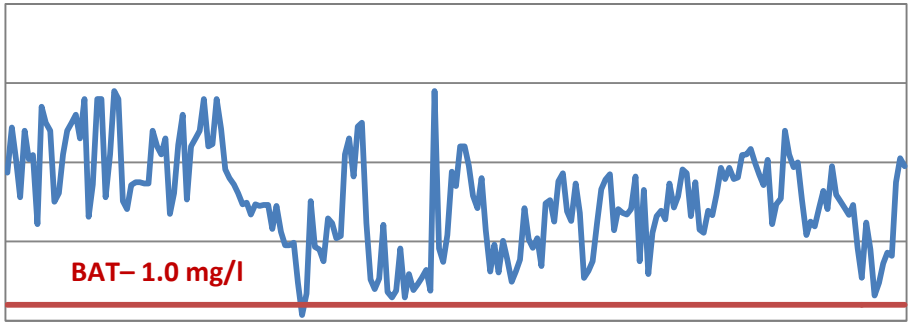
Treatment quality, mg/dm3

	Suspended solids	Ammonium nitrogen	Phosphorus phosphates	Nitrogen nitrates	BOD5	Total nitrogen	COD
Facilities	8.5	7.5	0.10	4.3	2.5	9.8	30
Technological parameter	10	1.0	0.7	9.0	8.0	10	80

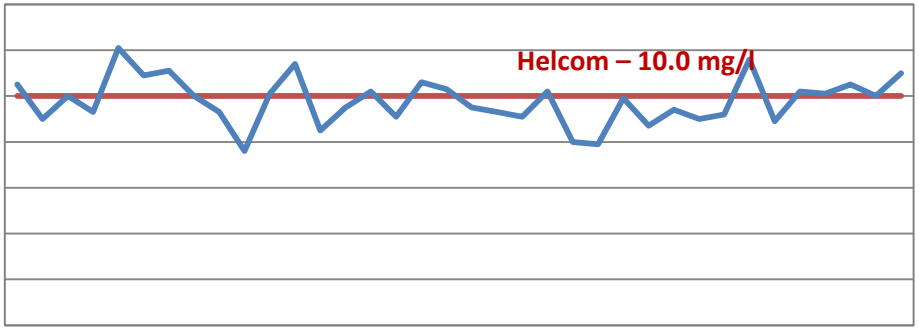
Suspended solids treatment trend



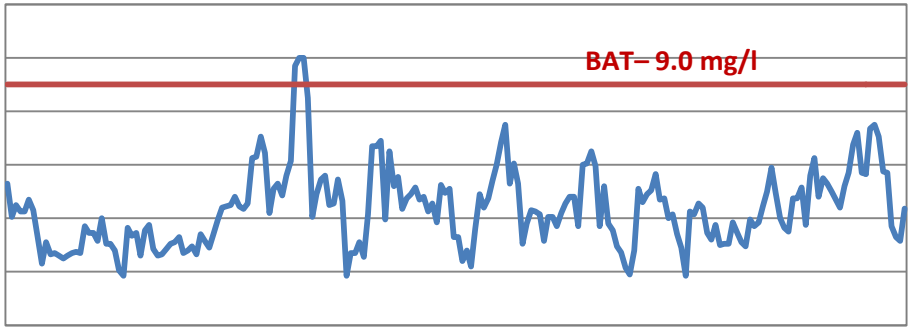
Ammonium nitrogen treatment trend



Total nitrogen treatment trend



Nitrogen nitrates treatment trend

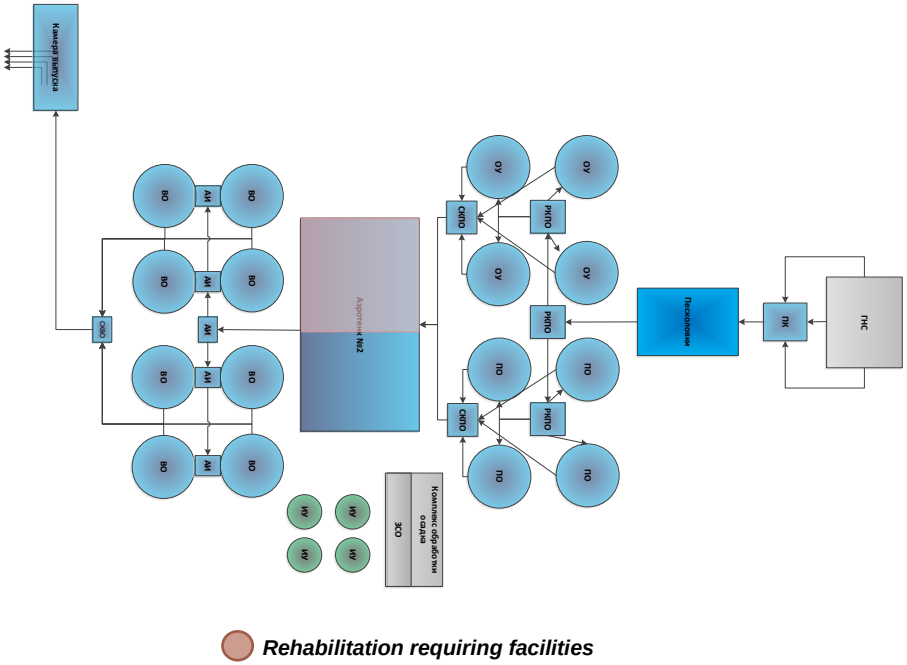


EPIP Planned Activities for the Central Wastewater Treatment Plant

- Reconstruction of the Central Pumping Station of the Central WWTP with replacement of the main pumping units and auxiliary equipment.
- Complete reconstruction of the mechanical treatment stage, including reconstruction of 6 primary sedimentation tanks.
- Complete reconstruction of the biological treatment stage with the enhanced nutrients removal technology implementation and reconstruction of 10 secondary sedimentation tanks.
- Tertiary treatment and disinfection facilities construction.
- Raw sludge preliminary fermentation process implementation.

South-West Wastewater Treatment Plant

South-west wastewater treatment plant characteristics	
Commissioning year	**2005**
Reduced capacity:	**290 thou.m^3/day**
Actual capacity in 2017:	**218.3 thou.m^3/day**



Rehabilitation requiring facilities

Current challenges

- Lack of tertiary treatment facilities. The applied technology does not provide sustainable quality of wastewater treatment with regards to suspended solids to reach the fishery requirements **(less than 5 mg/l).**
- According to the 2017 results, 65% of samples do not meet the established standards for specific pollution (not related to process controlled).

EPIP planned activitie

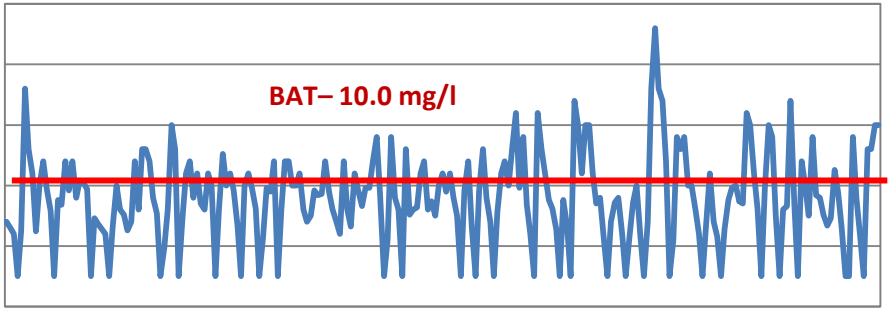
- 3 aeration tanks rehabilitation.
- Disinfection system rehabilitation.
- Tertiary treatment technology should be implemented to comply with suspended solids removal requirement.

South-West Wastewater Treatment Plant

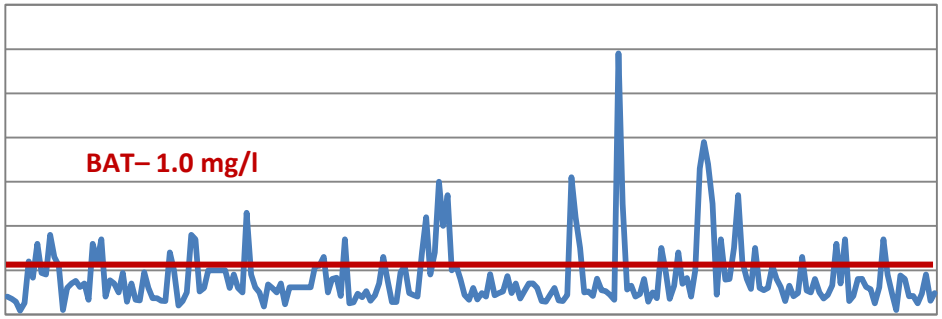
Treatment quality, mg/dm3

	Suspended solids	Ammonium nitrogen	Phosphorus phosphates	Nitrogen nitrates	BOD5	Total nitrogen	COD
Facilities	9.0	0.84	0.21	6.3	1.8	6.1	26
Technological parameter	10	1.0	0.7	9.0	8.0	10	80

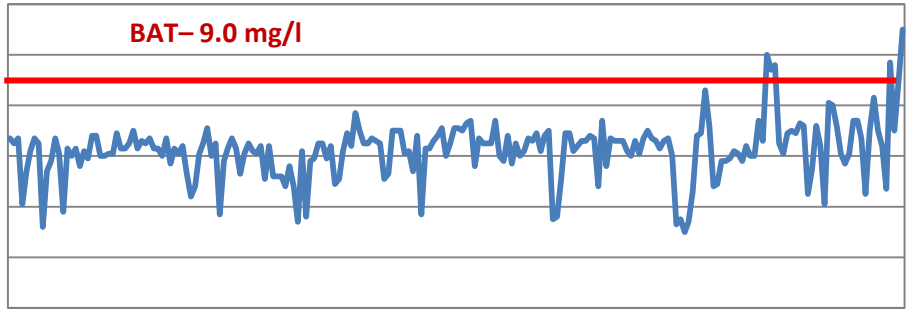
Suspended solids treatment trend



Ammonium nitrogen treatment trend



Nitrogen nitrates treatment trend



Characteristics of sources of air pollution for wastewater treatment plants, and sizes of established buffer zones

Plant	Sources of air pollution	Specified BZ size in compliance with SanPiN 2.2.1/2.1.1.1200-03
Central WWTP	• Open surfaces of treatment plants (unorganized fugitive sources): inlet chamber, grit channels, grit storage sites, primary clarifiers, aeration tanks, secondary clarifiers , distribution chambers, sludge thickeners • Emissions from ventilation of buildings (from leaks in the process equipment): main pumping station, mechanical treatment center, sludge treatment building, sludge incineration plant • SIP stacks •Auxiliary production: chemical & bacteriological laboratory, maintenance & repair shop, boiler plants, vehicles	500m from the SIP stack
Northern WWTP		20m northward, 100m – in other directions
South-West WWTP		210m in all directions

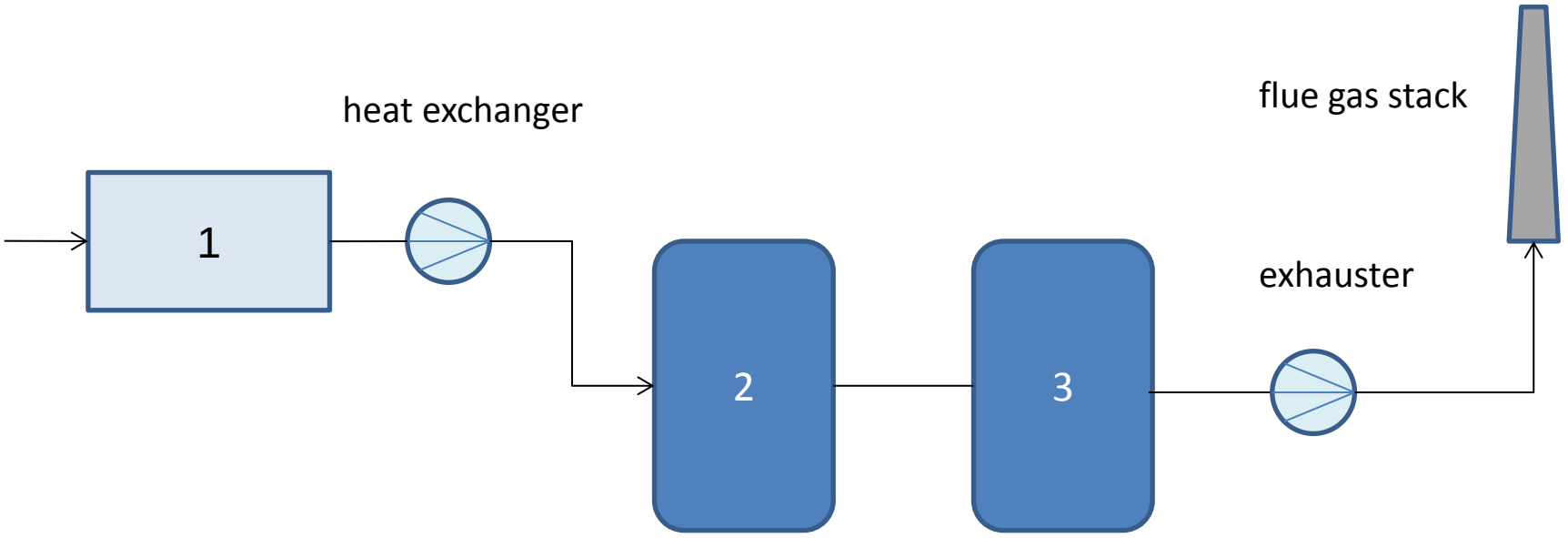
Atmospheric Emissions of NWWTP, CWWTP and SWWTP without SIPs

Amount:

- 25 pollutants, of which

- 1 class of hazard - none
- 2 class of hazard – 6 substances: manganese and its inorganic compounds, dihydrosulfide, gaseous fluorides, phenol, formaldehyde, monomethylamine.

Flue Gases Scrubbing Layout (dry) (NWWTP)



1 - Electrostatic filter

- volatile ash precipitation
- Scrubbing performance reaches **99.9%**

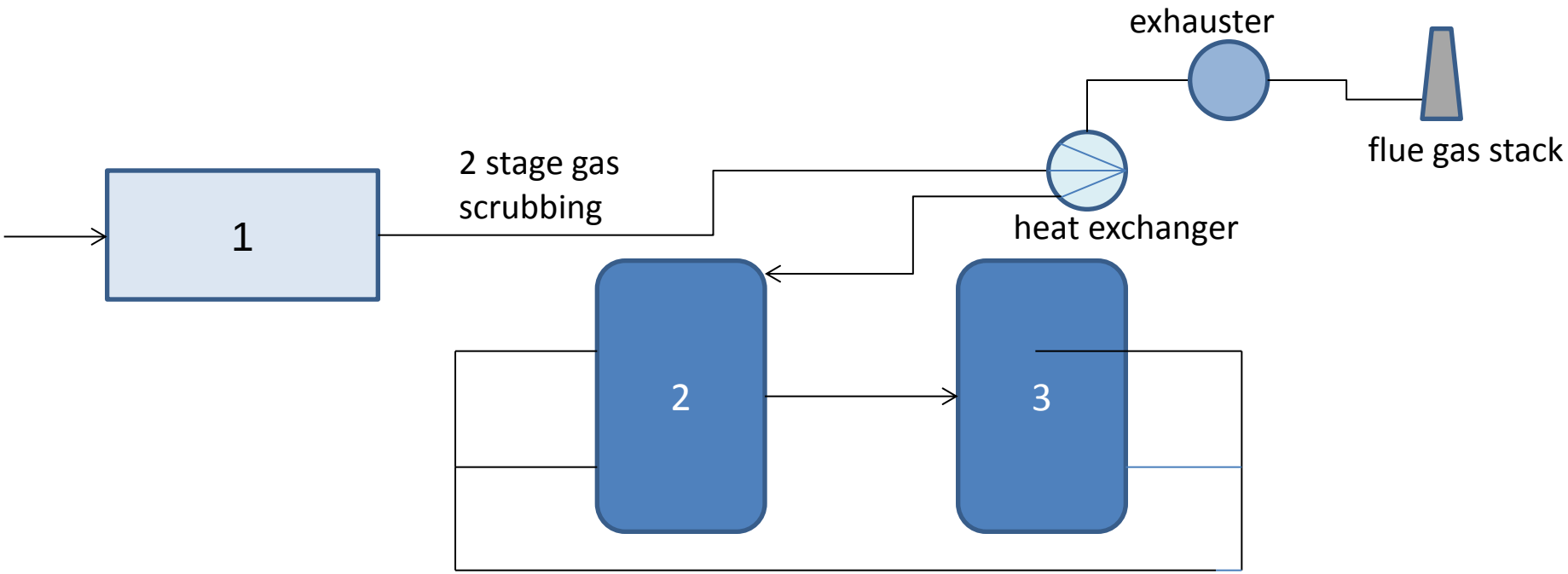
2 - Mixer

- sodium bicarbonate and activated carbon dosing

3 – Sack filter

- removal of HCL, HF, SO_2 , heavy metals
- Scrubbing performance is **95%**

Flue Gases Scrubbing Layout (wet) (CWWTP and SWWTP)



1 - Electrostatic filter

- volatile ash precipitation
- Scrubbing performance reaches **99.9%**

2 - I stage

- treatment with acid at scavenging scrubber
- HCL, heavy metals removal

3 - II stage

- neutralization at scrubber column
- SO2 removal
- Scrubbing performance is **99%**

Planned Activities for CWWTP SIP

Substance	Current situation	Design parameters of 1997	Outlook accounting new incineration lines construction
Dust	98,4	99,9	99
Sulfur dioxide	96,8	99,0	99

- Sludge treatment complex reconstruction with new sludge incineration lines construction
- Timeframe - 2018-2022

Innovative solutions

Sludge drying

Electric power and heat generating turbine

Absorber in gas scrubbing system

Improved treatment of process wastewater (LWWTP)

Designed incinerators № 5,6

Technological Parameters of Emissions and Conformity Assessment of Sludge Incineration Technology with BAT (BREF9 - 2015)

Substance	Hazard class	mg/m³		
		Actual CWWTP	BREF9-2015	IED
Nitrogen (IV) oxide	3	2.1	200	≤200
Nitrogen (II) oxide	3	0.37		
Sulfur dioxide	3	12.4	50	≤50
Carbon monoxide	4	2.1	50	≤50
Saturated hydrocarbons C_{12}-C_{19}	4	0.315	10	-
Carbon (soot)	3	-	10	-
Suspended solids (Inorganic dust 70-20% SiO_2)	3	8.178	10	≤10
Benzapyrene	1	<0.00007	0.001	-
Hydrogen chloride	2	0.79	10	≤10
Hydrogen fluoride	2	<0.12	1	≤1
Dioxines (expressed as 2,3,7,8-tetrachlorodibenzo-1,4-dioxine	1	<0.1 ng/m³	100 ng/m³	100 ng/m³
Mercury and its compounds	1	0.0003	0.05	≤0.05
Cadmium oxide	1	0.021	0.05	≤0.05
Thallous carbonate	1	-		

Technological Parameters and Conformity Assessment of Sludge Incineration Technology with BAT (BREF9 -2015)

Substance	Hazard class	mg/m³		
		Actual CWWTP	BREF9-2015	IED
Total rest heavy metals				
Vanadium pentoxide	1	-	0.5	≤0.5
Manganese and its compounds (expressed as manganese oxide)	2	0.023		
Cupric oxide (expressed as copper)	2	0.011		
Nickel oxide (expressed as nickel)	2	0.055		
Lead and its inorganic compounds (expressed as lead)	1	0.001		
Chrome (expressed as chrome (VI) oxide)	1	0.129		
Cobalt oxide	2	<0.013		
Antimony		-		
Arsenic, inorganic compounds (expressed as arsenic)	1	-		

Proposals for NWWTP, CWWTP, SWWTP Atmospheric Emissions Limitation

Proposal for setting BREF 9-2015 technological parameters for sludge incinerators

Proposal for setting standards for 2nd hazard class substances (6 substances) – under current MPEs

NWWTP, CWWTP, SWWTP Wastes

24 types of wastes, comprising:

I class – 1 (mercury lamps)

III class – 4 (pent oils)

IV class – 12:

- **(4) process wastes (ash, cake, screens wastes, sand)**;
- 8 (solid wastes, sweepings, rags, etc.).

V class – 7 (metal junk, food wastes, metal chips, etc.)

Wastes disposal

- **80%** of wastes is dewatered and disposed at SIPs;
- **19 %** of wastes is disposed at Vodokanal licensed landfills (process wastes, including ash);
- **1%** of wastes is disposed at solid wastes landfills.

Proposals: to set wastes generation standards and disposal limits at the level of current standards and limits

Sludge incineration plants

St. Petersburg is the first city to fully solve the problem of sewage sludge disposal.

Three sludge incineration plants are in operation at Vodokanal:

- Central SIP – since 1997
- Northern SIP – since 2007
- South-West SIP – since 2007

SIP advantages

- Ash is produced during the combustion of sludge. As a result, the volume of burnt sludge is 10 times smaller;
- No pathogens or evil smell in the ash;
- The concentrations of hazardous substances in the cleaned gases produced during sludge incineration meet the Russian and EU standards;
- The heat recovered from flue gases can be used for hot water supply and space heating;
- Ash can be used in industry;
- The steam generated can be used for electricity production.

Existing Sludge Treatment Process at SUE "Vodokanal of St.Petersburg" facilities

Wastewater sludge

Wastewater treatment plant → **Dewatering** → **Cake** → **Incineration**

Steam turbine

Electricity production

NWWTP (2007) – 186 tDS/day

SWWTP (2007) – 88 tDS/day

NWWTP SIP turbine and generator

Draft sludge volume: 122.4 tDS/day

Steam temperature - 450 °C

Steam pressure - 32 bar

Generator power: 2.5 MW

SWWTP SIP turbine and generator

Draft sludge volume: 68 tDS/day

Steam temperature - 450 °C

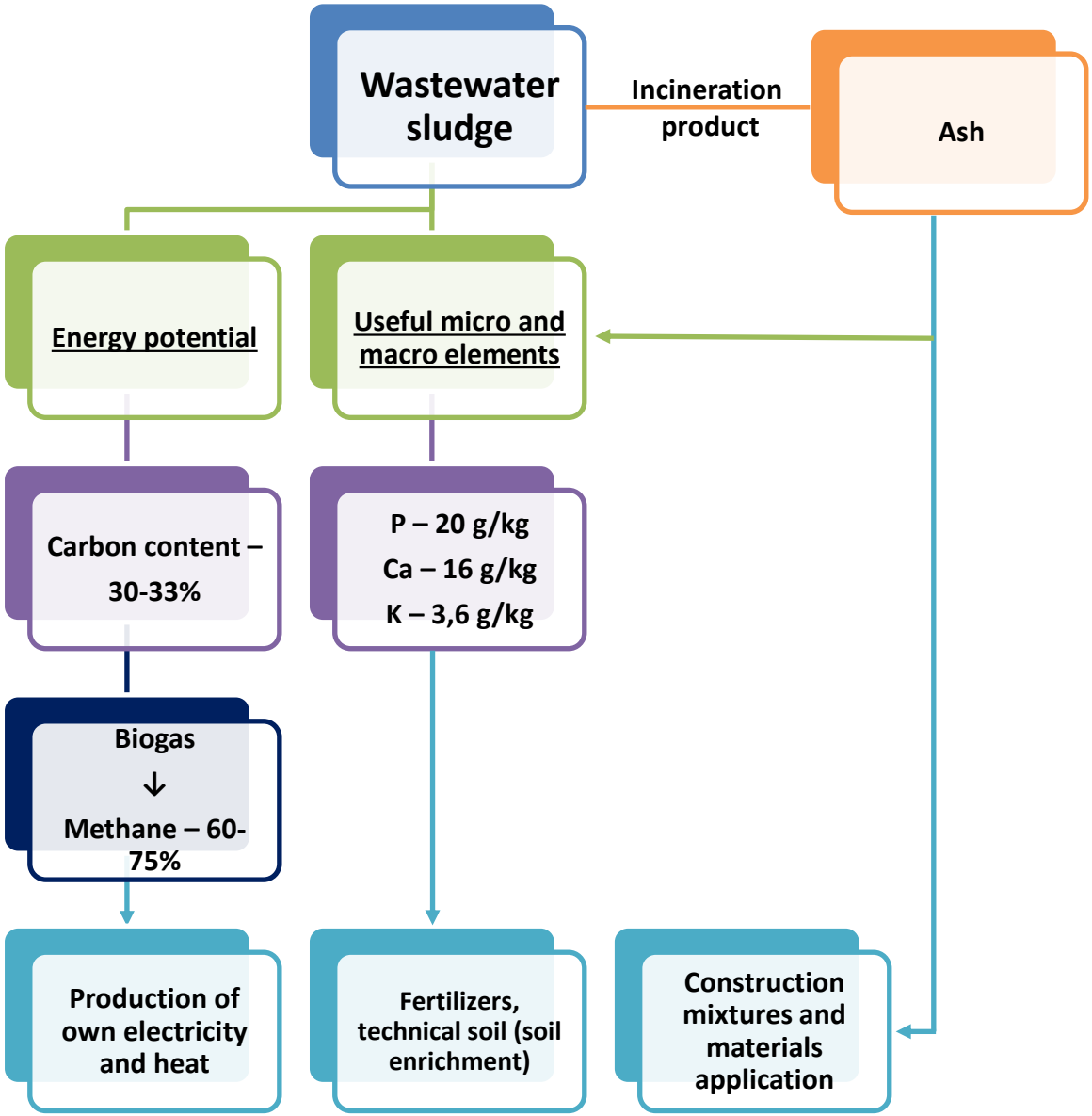
Steam pressure - 65 bar

Generator power: 1.1 MW

Comparison of sewage sludge disposal technologies (by an example of Central WWTP)

Item no.	Parameters			
		Incineration **BAT– 11г (in BREF 10-2015) H23-2,H23-4 (in BREF 10-2015)**	Anaerobic digestion **BAT 11a (in BREF 10-2015)**	Pyrolysis **П81Н and П82Н (in BREF 9-2015)**
1.	**Process stages**	• **Dewatering** • **Incineration**	• **Primary dewatering** • **Anaerobic digestion** • **Secondary dewatering** • **Reject water de-ammonation** • **Drying**	• **Dewatering** • **Drying** • **Incineration**
2.	**Central WWTP's demand for electricity from external sources**	**93 %**	**70 %**	**100 %**
3.	**Provision of back-up electric energy supply**	**Covers 7 % of energy demand (Main PS)**	**Covers 30 % of energy demand (Main PS and air blower)**	**None**
4.	Prime cost of sludge treatment per 1 t DS, '000 RUB.	8,8	10,6	9,0

Wastewater Sludge Application Options



Total heavy metals in Vodokanal's sewage sludge

Chemical elements, mg/kg DS	Year				Requirements of GOST P 17.4.3.07-2001, not higher than, mg/kg DS	
	2013	2014	2015	2016	Sludge Group I	Sludge Group II
Lead	120	56	120	160	250	500
Cadmium	**21**	**33**	**13**	**33**	15	30
Nickel	27	24	40	44	200	400
Chrome	93	71	68	87	500	1000
Zinc	800	680	800	730	1750	3500
Copper	220	170	240	200	750	1500
Mercury	0,75	1,7	0,83	1,0	7,5	15
Arsenic	4,5	3,3	3,6	2,7	10	20

– The regulatory values set forth in GOST P 17.4.3.07-2001 "Required parameters of the sewage sludge to be used as a fertilizer", are exceeded

Note: *If the concentration of one or more regulated elements exceeds the acceptable level for Group I, the sludge is attributed to Group II.*

Group I sludge is used for all kinds of cultivated crops except vegetables, mushrooms, leaf vegetables and strawberries.

Group II sludge is used for grain, pulse crops, grain-fodder and industrial crops.

Groups I and II sludge is used in commercial floriculture, green building, forest / decorative nurseries; for bio-reclamation of disturbed lands and MSW landfills

Sludge incineration plants

The Central SIP was put into operation in 1997
Number of sludge incinerators – 4

Design capacity per incinerator – 62.5 t DS/day
Corrected capacity per incinerator (2017) – 50.0 t DS/day

Key challenges of the Central SIP

The Central SIP has been in operation for 20 years. The design life of the main components is exceeded by more than 7 years.

In future, the Central SIP will work without observing the time between repairs to prevent sludge disposal to the landfill, hence, the wear of equipment will be still higher.

Sludge incineration capacity should be increased by building two new furnaces to ensure 100 % incineration of the city's sewage sludge and to prevent sludge landfilling.

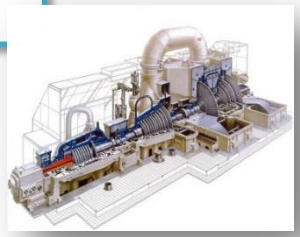
Process solutions to be implemented during the Central SIP reconstruction

Innovative solutions to be implemented at the Central SIP:

- **Pre-incineration drying of sludge to 30- 35 % humidity to reduce the sludge volume and to improve the calorific value**

- **Advanced wet gas cleaning system with additional steps to ensure effective removal of hydrogen sulfide and nitrogen oxides**

- **Turbine to produce electricity and heat**



Advantages of the sludge treatment scheme used in the Central SIP design:

1. The energy demand of the Sludge Treatment Complex will be **100 %** covered with the electricity produced on-site

2. The Central WWTP will be **100%** supplied with own-produced heat

3. Sludge incinerator construction cost is **1,5 times lower**

4. Gas cleaning system construction cost is **1,5 times lower**

5. A **50 %** reduction of natural gas consumption

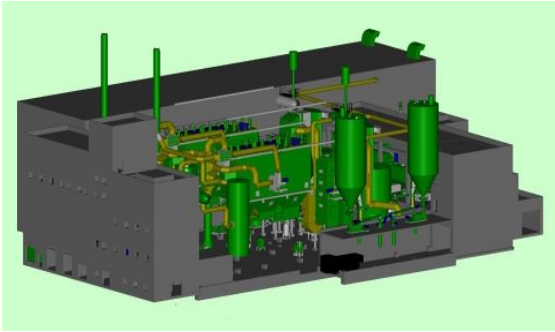
6. Heat emission to the environment is **80 %** lower

Outlook for sewage sludge treatment and disposal in St. Petersburg

First-priority goal: to ensure incineration of all sewage sludge produced in the wastewater treatment process in St. Petersburg.

Future goal: launching of waste-free production with no more sludge or ash disposed to landfills.

Construction of 2 new sludge incineration lines at Central WWTP



Potential use of ash in the national economy

Production of ash-based fillers for construction mixes

Production of organo-mineral fertilizers from ash

Production of vitrified ash

Geotube Substrate Based Soils

State Program **"Research and development in priority areas of the scientific and technological complex of Russia for 2007-2013".**

Public Contract No.16.525.11.5012 **"Development of technology for obtaining of materials based on processed utilities wastewater sludge"**

Average composition of dewatered wastewater sludge and cattle manure

Substance, g/kg	Silicon	Aluminum	Potassium	Calcium	Phosphorus	Sulfur	Iron
Sludge	2.6	14.0	**3.6**	**16.0**	**20.0**	8.3	23.0
Manure			**5.0**	**4.5**	**2.5**		

Mobile plant for soil production

Soils application:

One transport interchange of two levels, where the first technical category road requires ground reinforcement, with a total volume of 15,000 m3.

Legislation related to Water Supply and Wastewater Disposal Systems Development

Water supply and wastewater disposal systems development defining documents that were elaborated under 416-FZ dated 07.12.2011 "On Water Supply and Wastewater Disposal" requirements:

- ✓ St.Petersburg Water and Wastewater Master Plan up to 2025 with an outlook to 2030
- ✓ SUE "Vodokanal of St.Petersburg" Investment Program for 2016-2020.

Construction and rehabilitation (reconstruction) of wastewater treatment plants in settlements, urban districts
23,431.3 mln. rub

Reduction of negative impact on environment

Wastewater sludge disinvasion with modern techniques
5,419.4 mln. rub

Water supply and wastewater disposal systems current reliability is ensured with developed:

- ✓ SUE "Vodokanal of St.Petersburg" production programs for water supply and wastewater disposal

IP activity non-performance risk assessment

Investment and Production programs activities performance assessment

Calculation of the activities priority during the IP implementation

Activities performance assessment is based on:

- ✓ Order of the Ministry of Construction of the Russian Federation No. 162/pr dated April 4, 2014 "On Approval of the List of Reliability, Quality, Energy Efficiency Indicators for Centralized Hot Water Supply, Cold Water Supply and (or) Wastewater Disposal Systems; Order and Rules for Planned Values and Actual Values for Such Indicators Determining"

ВОДОКАНАЛ
САНКТ-ПЕТЕРБУРГА

Thank you!